RIO TINTO
LEGACY
MANAGEMENT

Rio Tinto AUM Company, Inc
4700 Daybreak Parkway
South Jordan, Utah 84095

USA

DOCUMENTATION OF THE 2016

EXCAVATION RESPONSE ACTION

ARMOUR ROAD SITE

RESPONDENT

Rio Tinto AuM Company
4700 Daybreak Parkway
South Jordan, UT 84095

PREPARED AND SUBMITTED BY

Gerald Pepper

Ross V. Overby

May 24, 2017

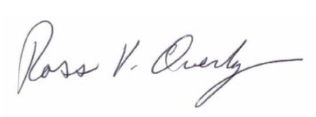
CERTIFICATION OF COMPLAINCE WITH THE CONSENT DECREE

Environmental response actions have been completed at the Armour Road Site in accordance with the Consent Decree - Civil Action Number 4:10-cv-00057-SOW and the approved Designs, Specifications, and Work Plans. The sampling and analytical testing completed during the response actions demonstrated that the cleanup standard (maximize the removal of arsenic-contaminated soil that is a potential source of arsenic affecting groundwater quality) has been achieved at the Site. In all locations where the sidewall concentrations of arsenic were elevated and further excavation was practical and safe, the excavation was expanded to remove as much arsenic mass as possible. The excavation extended to the water table where needed to remove arsenic-impacted soil at depth.

Per the Consent Decree - Civil Action Number 4:10-cv-00057-SOW (CD) – I make the following Certification:

Under penalty of law, I certify that to the best of my knowledge, after personally supervising the response action, making appropriate inquiries of all relevant persons involved in the response action and in the preparation of the documentation report, that the information submitted is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of a fine and imprisonment for knowing violations.

“CERTIFIED”



Ross V. Overby

Missouri Registered Geologist # 0988

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ACRONYMS

AASHTO	American Association of State Highway and Transportation Officials
AIHA	American Industrial Hygiene Association
BNSF	Burlington Northern Santa Fe
Borax	US. Borax
CD	Consent Decree specifically Civil Action Number 4:10-cv-00057-SOW
COC	Chain of Custody
DI	Drop Inlet
DRI	Direct Reading Instrument
FS	Feasibility Study
HABCO	Horne and Boatwright Company
HASP	Health and Safety Plan
HQ	Hazard Quotient
ILCR	Incremental Lifetime Cancer Risk
KCP&L	Kansas City Power and Light
LTM	Long Term Monitoring
MDNR	Missouri Department of Natural Resources
MEP	Modified Extraction Procedure
Mg/kg	Milligrams per kilogram
Mg/L	Milligrams per liter
Mg/m^3	Milligrams per cubic meter
MNA	Monitored Natural Attenuation
NIOSH	National Institute for Occupational Safety and Health
MODOT	Missouri Department of Transportation
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NKC	North Kansas City
NS	Norfolk Southern
OSHA	Occupational Safety and Health Administration
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance Quality Control
RA	Removal Action
RCP	Reinforced Concrete Pipe
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RP	Responding Party
SITE	2251 Armour Road Parcel
TCLP	Toxicity characteristic leaching procedure
TFE	Teflon Filter
USEPA	United States Environmental Protection Agency
XRF	X-ray Florescence
µm	Micrometers

EXECUTIVE SUMMARY

The following report summarizes the history leading up to the excavation and Site restoration activities completed at the Armour Road Site in 2016/2017. Work began on September 26, 2016 and was completed on January 20, 2017. The cleanup activities were conducted as a Removal Action (RA) in accordance with Consent Decree - Civil Action Number 4:10-cv-00057-SOW (CD), the "*Final Work Plan Addendum - Work to Complete the Feasibility Study*" dated November 30, 2015, the "*Quality Management Plan/Quality Assurance Project Plan Incorporating the basic aspects of Field Sampling and Analytical Plans*" dated March 18, 2016, and the "*Contract Drawings Remedial Action Design and the Project Specifications*" dated June 15, 2016.

The Site, as applied to the RA, is composed of two parcels. One parcel is a rectangular area lying under Railroad Avenue parallel to the Burlington Northern Santa Fe (BNSF) railroad tracks. This parcel measures about 265 feet long by 65 feet wide. The second parcel is referred to as the "Sutherlands parcel". This is a parcel where a Sutherlands home improvement store was once located. The Sutherlands parcel, as it relates to the RA, is a 250 foot by 250 foot square footprint of the former building and a 175" long by 40 foot wide extension from the eastern edge of the footprint to Armour Road. Both parcels are owned by the City of North Kansas City (NKC).

Between these two RA parcels lies the 1.8 acre 2251 Armour Road Site (Site) which is the land parcel subject of the CD. The Site was used as a herbicide repackaging and processing center from the 1920s up to 1986. The processing and repackaging operations were conducted by Reade Manufacturing from the 1920's until 1963. U.S. Borax leased and operated on the property from 1963 until 1968 when the property reverted to Reade. Horne and Boatright Company (HABCO) subsequently acquired the property and continued the herbicide processing until the operations were closed in 1986 when it reverted to an ownership entity called KC-1986. NKC acquired ownership of the Site in April 2012.

In 2006 a RA was completed addressing the entire 1.8 acre Site. The 2006 RA excavated the entire 1.8 acres down to a depth of about 24 feet. The contaminated soil was disposed off-site and the excavation was backfilled with clean soil. The RA revealed that arsenic contamination extended to the east of the Site under Railroad Avenue and to the west under the Sutherlands building. These areas to east and west of the Site could not be addressed due to the presence of the road and the building. A general execution plan was put in place in 2006 where the area under Railroad Avenue and the Sutherlands building would be addressed at a later date when these structures were no longer obstacles.

Since 2006 NKC has created a redevelopment plan for about 70 acres that includes the Site. The redevelopment plan included removing the Sutherlands building which made temporarily rerouting Railroad Avenue viable. The execution of the City's redevelopment plans began in 2016 which opened a window of opportunity to execute the final RA on the Sutherlands and Railroad Avenue parcels.

The final RA was conducted according to the approved work plans and the CD. The work performed is summarize below

Site Security – The two parcels were secured with a fence. The fence remained in place throughout the RA. Specific points of entry and exit were established. These entry/exit points were locked when work was not being conducted.

Air Monitoring - An air monitoring program was implemented to ensure protection of the general public and Site workers during the cleanup activities. In general, the air monitoring program included the following elements:

- Ambient work area monitoring; and
- Worker monitoring.

The ambient and worker exposure data were below the standards that protect the health of the workers.

Storm Water - Two open storm sewers were located in the southern part of the Site near Railroad Avenue and one storm sewer was located on the north area of the work area of the Site. These sewers were protected with silt fencing and/or sediment traps.

Power Line Relocation – A power line owned by Kansas City Power and Light (KCP&L) cut across the Railroad Avenue excavation area. KCP&L permanently relocated the power line out of the work area.

Road Construction/Demolition – An asphalt temporary access road was built from Vernon Avenue to the Norfolk Southern rail yard. After the temporary road was placed in service Railroad Avenue was demolished and the road materials were recycled off site. When the Railroad Avenue excavation was complete the road was rebuilt to a plan provided by the NKC and the temporary road was removed. The asphalt from the temporary road was recycled off site. The road base, being clean import, was used as backfill for the RA excavation.

Water Service Shutdown – A section of the NKC municipal water system cut across the Railroad Avenue excavation. The regional water distribution was such that the pipe segment across the work area could be shut down during the RA. A new water valve was installed to isolate the pipe in the work area and the service crossing the Site was shut down. The pipe was removed from the excavation area as the RA proceeded. When the RA was complete the pipe segment was replaced and the segment was put back into service.

EXECUTIVE SUMMARY

Excavation, Treatment, and Disposal - The excavation work proceeded in an orderly manner to maximize the removal of arsenic-containing soil, and to document the remaining arsenic concentrations in the bottom and sidewalls of the excavation. The excavation work began in the Railroad Avenue area. A 72" storm water sewer under the road trace was removed as the RA proceeded. The storm sewer was replaced when the RA excavation reached its limits. New storm water drop inlets and pipe connector boxes specified in the NKC design for Railroad Avenue were built. Once the storm water controls were rebuilt the open pit was backfilled and Railroad Avenue was rebuilt. After Railroad Avenue was rebuilt the excavation work was conducted on the Sutherlands parcel.

Throughout the RA an X-ray fluorescence (XRF) instrument was used to document the concentrations of arsenic in excavated soil. As soil was excavated and stockpiled soil samples were collected. A treatment product called EnviroBlend®, was used to treat soil when needed rendering it non-hazardous. EnviroBlend was used on all soil where the leachable concentration of arsenic in the Toxicity Concentration Leaching Procedure (TCLP) exceeded the regulatory limit of 5 milligrams per liter (mg/L).

To document the effectiveness of the soil treatment process, pre- and post-treatment samples of soil were analyzed for total and toxicity concentration leaching procedure (TCLP) arsenic concentrations. To document the concentration of arsenic left in the sidewalls and bottom of the excavation the XRF data were supplemented with 10% off-site laboratory confirmation analyses.

A total of 44,241.96 tons of soil were excavated from the two parcels. 19,080.26 tons were removed from the Railroad Avenue parcel and 25,161.70 tons were removed from the Sutherlands Parcel. A total of 27,724 kilograms of arsenic was removed from the Site. All soil was disposed at the Courtney Ridge landfill. A manifest was used to record each load of soil delivered to the landfill.

Documentation of Soil Quality Underlying Soil Staging Area - As the excavation progressed it was necessary to place and treat contaminated soil on areas of the Site that were not in the excavation work areas. When the RA was complete the soil pile staging area was scraped to reveal in-situ soil and the area was tested for arsenic on a grid pattern. The soil pile area was considered clean when the average residual arsenic concentrations were less than 70 milligrams per kilogram (mg/kg). Areas were re-scraped when the sampling revealed an area of impacted surface soil.

Excavation of Miscellaneous Materials – 1,347.5 tons of concrete and asphalt were removed from the Site and sent to Obermeyer Reclaim in Independence Missouri. The concrete and asphalt came from roads that were removed.

No underground structures were known to exist. During the excavation on the Sutherlands parcel several large buried concrete structures were discovered. The structures were discovered at a depth where a continuous limestone gravel layer, that appears to be a historic land surface, was found. The structures include a sump, six footings supported by wooden piers, and several smaller concrete supports that appear to have once supported small structures. Several pipes were also found in association with the structures. Very high arsenic concentrations were found in and around these structures as well as high concentrations of copper and iron, what appeared to be iron-containing slag, and a tar-like substance. The underground structures, piping, and associated contaminated soil were removed to access arsenic-containing soil connected with the HABCO parcel. The concrete was found to be uncontaminated so it was left in the excavation at a depth greater than 15 feet.

Backfill and Site Closure - Imported backfill was obtained from two sources; the Pursell Borrow Pit and on-Site soil that had average arsenic concentrations less than 70 mg/kg. The soil from Pursell was brown loess, commonly used as structural fill in the region. The on-Site soil was native material and backfill from the 2006 RA that had to be removed to access underlying or adjacent contaminated soil. On-site soil was known to be uncontaminated based on the Remedial Investigations. Soil from the off-site backfill source was tested for organic contaminants, metals, and its geotechnical properties.

All detected compounds in imported fill samples met the backfill specifications. The concentrations of metals, including arsenic, were consistent with background values. The backfill was free of fuel and solvent compounds. Backfill was placed as the excavation progressed. Compaction testing was done daily as backfilling was being done. The compaction specification for the project was achieved in all areas of the RA.

The entire area affected by the RA will be regraded and filled as part of the regional commercial development. The development is scheduled to commence in the spring of 2017. Given that the Site surface will be subject to ongoing grading, topsoil and vegetation was not placed on the RA area. Strom sewers were protected with silt fencing and hay bales to prevent sediment migration into the storm sewer system.

Post Closure Activities – The entire work area was returned to unsecured open ground and was release to the NKC for their use. The interim post-RA access is restricted to the surface of the Site. Before the Site is released for work at depth (excavations, utility installation etc.) access restrictions, issued by the appropriate government agencies, are needed that inform the Site owner of the remaining contamination at depth. Contamination of various types (arsenic, copper, iron, char, tars), primarily from the past industrial uses on the Sutherlands parcel, remain at depth. The location and extent of the remaining contamination, to the extent that it is known, is documented in this RA documentation report. The oversight Agencies will formally establish appropriate deed restrictions for the Site. Deed restrictions will provide the Site maintenance requirements and the communication mechanisms to ensure that future developers of the Site are aware of the conditions of the Site and can take proper measures when developing the Site.

A groundwater monitoring program is being planned to document the effectiveness of the RA on groundwater quality. The monitoring plan will be focused on documenting Monitored Natural Attenuation (MNA) processed as well as the benefits gained by the RA. The monitoring plan will be a stand-alone document that identifies the monitoring locations, the sampling frequency, sampling methods, analytical parameters and lab procedures, and the data evaluation criteria.

CERTIFICATION OF COMPLIANCE WITH THE CD

All requirements of the CD were achieved by the RA. The following report provides specific details on how the requirements were met, documents the disposal of the excavated and treated soil, and documents the concentrations of arsenic that were left in place.

1.0 INTRODUCTION

This report documents the execution of the 2016 Removal Action (RA) conducted at the 2251 Armour Road Site (Site) in North Kansas City, Missouri. The cleanup activities were conducted as a voluntary RA in accordance with Consent Decree - Civil Action Number 4:10-cv-00057-SOW (CD). U.S Borax (Borax), wholly owned by Rio Tinto, accepted the role as the Responding Party to the CD. The environmental actions required by the CD have been managed by a Rio Tinto subsidary referred to as Rio Tinto Areas under Management Company, LLC (hereafter referred to as The Responding Party, or otherwise RP). The RA was executed by the RP on behalf of U.S. Borax.

Work began on September 26, 2016 and was completed on January 20, 2017. This documentation report is divided into the following sections:

- The introduction continues with a brief overview of the Site setting, the principal features at the Site, the operational history, and an overview of the response actions approved by the United States Environmental Protection Agency (USEPA).

- Section 2.0 provides an overview of the specific administrative and preparatory actions taken to comply with the CD and prepare the parcels for the excavation.

- Details of the excavation, treatment, and Site closure activities, the analytical data for the soil removed, treated, disposed, and the backfill soil are provided in Section 3.0. Section 3.0 also documents the observations and discoveries made during the excavation, the arsenic concentrations in the soil left in place, and the efforts made to maximize the removal of the mass of arsenic at the Site.

- Section 4.0 documents the RA closure activities.

- The post closure requirements are provided in Section 5.0

- A photo record is provided in section 6.0.

1.1 SITE LOCATION AND DESCRIPTION

The Site is comprised of multiple components. The physical Site is a triangular area approximately 1.8 acres in size and is located at 2251 Armour Road in North Kansas City, Missouri. Figure 1-1 shows the location of the Site. The "Site", as addressed by the CD, also includes groundwater that has been impacted by arsenic migrating from the physical property at 2251 Armour Road and arsenic that migrated laterally through the soil onto adjacent parcels.

The RA document herein addresses the arsenic that migrated laterally through the soil onto adjacent parcels. Therefore, for the purpose of this documentation report the term "Site refers to the 2251 Armour Road property. The Site is open land bounded by Armour Road to the north, Railroad Avenue to the east, the Burlington Northern and Santa Fe Railroad (BNSF) to the south, and a parcel, that until August 2016 was the site of a Sutherlands' home improvement store, to the west. A Site diagram is presented as Figure 1-2.

A complete RA of the 2251 Armour Road property was done in 2006. During the 2006 RA lateral migration of arsenic was noted along Railroad Avenue and along the Sutherlands building. It was clear that arsenic had migrated into soil under the road and under the building. The 2006 RA was deemed complete to the extent possible at that time and the continuation of the RA under the road and building was differed until a plan could be developed to complete the source removal.

Since 2006 the City of North Kansas City (NKC) developed an urban redevelopment plan for the area along Armour Road that included the 2251 Armour Road property. The redevelopment plan included the removal of the Sutherlands building which provided a technical ability to temporarily relocate Railroad Avenue providing access to the source under the road, and the opportunity to excavate any potential source that existed under the footprint of the Sutherlands building.

The Respondent divided the Site into two RA work areas; one referred to as the Railroad Avenue parcel, and the second referred to as the Sutherlands parcel. The location of these work areas are shown on Figure 1-3. At the time of the RA the Sutherlands building was torn down. The work areas of the RA were completely open land. The only physical structures and/or features on and under the Site at the time of the RA were as follows:

1. Railroad Avenue Area

- The road itself;
- Three storm sewer drops, one located near the north boundary of the Site which drained into a storm sewer pipe running parallel to Armour Road. A second storm water drop is located along the east boundary of the Site. This storm sewer leads to a 72-inch storm sewer running under Railroad Avenue. The third storm sewer system is located at the southern end of the Site;
- Two KCP&L power poles and the associated overhead power lines;
- A 72" storm water pipe;

- A 10” municipal water pipe; and
- Three groundwater monitoring wells.

2. **Sutherlands Area**

- Asphalt paving surrounding the footprint of the former Sutherlands building;
- An active storm water sewer inlet along the northern portion of the work area;
- Three inactive storm sewers located around the west and south footprint of the former building.

How these features were either protected or relocated at the start of the RA is discussed in Section 2.0.

1.2 SITE HISTORY

The Armour Road Site was used as an herbicide repackaging and processing center from the1920s up to 1986. The processing and repackaging operations were conducted by Reade Manufacturing from the 1920s until 1963. Borax leased and operated on the property from 1963 until 1968 when the property reverted to Reade. HABCO subsequently acquired the property and operated a herbicide repackaging and processing facility on the Site until the operations were closed in 1986. Starting in 1986, the Site was owned by an entity referred to as KC 1986. On April 4, 2012 NKC purchased the Site.

In 1996 arsenic contamination was discovered on the Site. The USEPA secured the Site with fencing and covered the contaminated soil with gravel. Several stages of Site investigations and response actions were conducted from 1996 to the present (see Subsections 1.3 and 1.4).

In 2004 the Respondent tore down the structures on the Site and conducted an excavation RA that was completed in 2006. In August 2016 the NKC tore down the Sutherlands building. The 2251 Armour Road property and the Sutherlands property are both owned by the City of North Kansas City.

1.3 ENVIRONMENTAL INVESTIGATIONS

A number of environmental investigations have been completed on the Armour Road Site. All of the investigations were compiled into a Remedial Investigation (RI) report of the Site. The RI report was published May 13, 2013. After the RI was accepted by the USEPA work began on the Feasibility Study (FS). A FS report titled “*Detailed Evaluation of Alternatives; Comparative Assessment of Alternatives; and Alternatives Analysis for Institutional Controls*” was published August 20, 2014.

The detailed evaluation of alternatives revealed that the remaining arsenic source under Railroad Avenue and the Sutherlands building complicated the evaluation and selection of a final remedy for the Site. The best path forward was determined to be:

1. Removing the remaining source to the extent practical;
2. Document the benefits of the source removal on groundwater quality; and
3. Document the natural attenuation properties of the groundwater system.

Based on the path forward a plan was developed to conduct a final RA.

1.4 APPROVED REMOVAL ACTION

The RA was approved by the USEPA with concurrence by the Missouri Department of Natural Resources (MDNR). The approval was based on through planning and documentation provided by the Respondent.

1.4.1 Approved Documents

Several stages of planning, agency review and approval were followed to execute the RA. A work plan titled *"Final Work Plan Addendum Work to Complete the Feasibility Study"* dated November 30, 2015 was prepared and approved by the USEPA. This work plan outlined the steps that would be taken to plan and design the details of the RA. Details of the sampling and analytical program to document the RA and the follow-up groundwater monitoring that would be performed to document the MNA processes in the groundwater were specified in the work plan.

Following the detailed requirements of the work plan an RA design was prepared in mid-2016. The design included a geotechnical report dated June 16, 2016. The geotechnical study documented the stability of the slopes that would be created when the Site was excavated during the RA. The design was held in draft form until the Sutherlands building was torn down and a focused subsurface study was conducted under the footprint of the building.

A document titled *"Project Specifications of the Removal Action"* dated June 15, 2016 was issued. The specifications were not dependent upon what might be found under the Sutherlands building so the specifications were issued when they were complete.

A report titled *"Soil Study – Sutherlands Parcel"* was published September 21, 2016. Concurrent with the writing of the Sutherlands soil study report the RA design was updated and the final *"Removal Action Design"* dated September 8, 2016 was issued. The design drawings and specifications provided the specific details for each step of the RA and addressed the interests and requirements of each stakeholder in the RA. The stakeholders were the following organizations:

- The USEPA;
- The MDNR;
- North Kansas City;
- Missouri Department of Transportation (MODOT);
- Burlington Northern Santa Fe Railroad (BNSF);
- Norfolk Southern Railroad (NS); and
- Kansas City Power and Light (KCP&L)

Meetings were held with each of these entities as the design and specifications were being prepared to review their needs, interests, and requirements and to include their needs in the RA design.

A "*Quality Assurance Project Plan*" (QAPP) dated March 18, 2016 was prepared and approved by the USEPA. The QAPP specified the sampling procedures sample handling, analytical methods, quality assurance testing, and reporting requirements for analytical data acquired during the RA.

A "*Health and Safety Plan*" (HASP) was issued in August 2016. The HASP specified all procedures to be followed and the monitoring to be done to assure the safety for the people working on the RA and to secure the safety of the public at large.

1.4.2 Modifications to the Approved Documents

The QAPP was modified twice during the RA. The first modification titled "*Work plan Addendum Removal Action Work Plan; Addendum Number #14 to the CD*" was dated October 3, 2016. The modification removed the requirement to conduct TCLP analyses on soil with low concentrations of arsenic. A procedure was added to average the arsenic concentration results from the multiple composite samples collected from each pile of excavated soil. The TCLP analysis schedule was modified to run TCPL analyses on soil samples collected from soil piles that were destined for the landfill (i.e. arsenic concentrations exceed 70 mg/kg in the bulk of the samples collected.)

The QAPP modification confirmed that ten percent (10%) of the samples tested with the XRF would be sent for laboratory confirmation of the XRF result. The average of all analytical data (lab and XRF) were used to document that a soil pile, as a whole, had arsenic concentrations less than 70 mg/kg. The QAPP modification specified that unusually high concentration outlier results, that greatly exceed 70 mg/kg for an individual sample from a pile, would be assessed on a case by case basis and the disposition of the pile would be coordinated with the USEPA.

The second QAPP modification titled *"Work Plan Addendum - Removal Action Work Plan; Addendum Number #15 to the CD"* was dated November 4, 2016. This modification revised the sampling program for the RA based on documented data trends revealed by the XRF testing. XRF testing had shown consistent results within a soil pile so the number of samples tested within a soil pile was reduced. The sampling frequency was modified to a rate of four (4) samples per 80 ton pile; confirmation samples were modified to one (1) sample per 160 tons, and TCLP tests were modified to be done at a rate of four (4) samples per 80 tons treated.

1.5 CHANGED CONDITIONS

As will be discussed in detail below in the documentation of the execution of the RA two unexpected conditions were encountered during the RA that were inconsistent with the design of the RA. The first changed condition was the physical nature of the contamination. All evidence from the RI and the nature of the contamination discovered during the RA completed in 2006 indicated that the arsenic would exist as a bulk mass that diffused away from the source. The arsenic discovered during the 2016 RA existed as migration channels of very high arsenic concentrations (exceeding 38,000 mg/kg) that expanded laterally and vertically as filaments up to a foot thick. The filaments were bright yellow to orange in color and tended to contaminate the fringes of the migration channels instead of creating a mass of soil that could be excavated in bulk.

Filaments could not be cost-effectively excavated surgically so a bulk of soil with lower arsenic concentrations had to be excavated along with the filaments to remove the migration channels. As the excavation proceeded laterally the filaments thinned to the point where thousands of tons uncontaminated soil was present above and around the filament. The excavation proceeded laterally until it was no longer cost-effective to remove thousands of tons of soil to access filaments that measured inches thick. The locations where filaments are known to remain in place are noted in the subsequent Sections of this documentation report.

The second changed condition was the discovery of remnants of historical industrial operations, unrelated to the Armour Road Site operations, at depth on the Sutherlands parcel. Concrete foundations on piers, where large industrial structures once stood, and a sump were discovered. High arsenic concentrations as well as high concentrations of bright green copper-stained soil, red iron-stained soil, black char, and a tar substance were found in close association with these structures. The structures had to be removed by the Respondent to access other areas of the Sutherlands parcel that were the target of the RA under the CD.

2.0 ADMINISTRATIVE PROCESS

The principal objective of the RA was remove arsenic-impacted soil that is, or could act as, a source of arsenic affecting groundwater. The RA tasks that achieved this objective were excavating soil, treating the soil when need to render it non-hazardous, disposing the soil in an approved landfill, and backfilling the excavation with clean soil. These RA tasks could only be conducted after several administrative tasks were completed. There were also several logistical construction, demolition, and reconstruction tasks that had to be conducted to make the excavation possible. This Section provides an overview of the administrative and construction/demolition/reconstruction steps performed to meet the project goals.

2.1 CONTRACTOR SELECTION

The contractor selection process followed a two-step competitive bidding process. Six bidders were identified in a pre-qualification review process. The prequalification process involved a review of the following pre-qualification criteria:

- Bidders past history in performing projects of a similar nature;
- The qualification and availability of the resources each bidder could dedicate to the project;
- The safety history of the firms, and
- A review of their understanding of the requirements of the project.

The bidders that went through the prequalification review are listed in Table 2-1.

Table 2-1
List of Potential Bidders

1. American Integrated Services;
2. Environmental Management Alternatives (EMA);
3. Arcadis;
4. Kissick;
5. Genesis; and
6. Environmental Resources Management (ERM).

Each bidder provided a written pre-qualification proposal responding to these evaluation criteria. The respondent reviewed each proposal and ranked the pre-qualified bidder’s responses. Based on the ranking of the bidders responses the following bidders were asked to provide a bid to execute the RA:

Table 2-2
Firms Asked to Bid

1. American Integrated Services (AIS);
2. Environmental Management Alternatives (EMA);
3. Arcadis; and
4. Genesis

Arcadis and Genesis elected to bid as a joint venture.

A pre-bid meeting was held at the Site and each bidder was required to attend. During the Site meeting the bidders became familiar with the Site conditions and the Respondent reviewed the plans and specifications. A question and answer period of several weeks after the pre-bid meeting was allowed.

Formal bids with cost estimates were received from the contractors and were reviewed for completeness (addressing all aspects of the project), the contractor's understanding of the project goals, the contractor's approach to meeting the stated goals, the contractor's experience with similar projects, and the unit prices for the elements of the project. The entire bidding, contractor selection, and contracting process was managed through the Rio Tinto Procurement Department. Based on all the evaluation factors AIS was found to provide the best overall value and provided the lowest cost. AIS was selected to execute the RA under the direct supervision and direction of the Respondent.

The RA project team consisted of AIS, AMEC-Foster Wheeler (AMEC), and the Respondent. AIS served as the executing contractor; AMEC worked with the Respondent to document the following aspects of the project:

- That all work activities were consistent with the RA Work Plan, design, specifications;
- That the requirements of the CD were met;
- To document the management of all wastes generated and disposed; and
- To document all material brought onto the Site for use as backfill.

The Respondent supervised all aspects of the RA, maintained communications and coordinated with all project stakeholders, and maintained the documentation record.

2.2 RESPONSE ACTION PREPARATION ACTIVITIES

The excavation component of the RA was complicated by several Site features that had to be managed so the excavation could proceed unhindered. Some of the complicating Site features included there being no on-Site facility to serve as a field work office, there was no Site security, Railroad Avenue was the only access to the NS railyard, KCP&L power poles were located where the excavation had to be conducted, and a 72” storm sewer and a municipal water pipe were located where the excavation under Railroad Avenue had to be conducted. The principal preparatory steps taken to address these complicating Site factors were as follows:

- Mobilization to the Site;
- Removal of two power poles and the relocation of the power lines that crossed the Railroad Avenue work parcel;
- Removal of miscellaneous debris including vegetation, and asphalt remaining on a portion of the Sutherlands parcels involved in the RA;
- Building a temporary access road from the intersection to Armour Road and Vernon Avenue to the BNSF and NS railroad crossing;
- Relocation of an existing water supply line; and
- Protecting operational storm sewers draining the Site.

These preparatory activities are briefly described below. Were the actions occurred are shown on Figure 2-1. The focus of the RA, the excavation of contaminated soil and backfilling the Site, is discussed in detail in Section 3.0.

2.2.1 Mobilization to the Site

Mobilization occurred on September 24, 2016. On that day a field office was delivered to the Site, and fencing was place around the entire work area. A central corridor was left in the fencing for the construction of a temporary public access road from Armour Road to the Norfolk Southern (NS) Railyard. Figure 2-1shows the location where the office and fencing was placed.

The fencing was placed to facilitate traffic movement through the Site, particularly trucks being loaded with contaminated soil and leaving the Site, and trucks entering the Site to deliver base rock and backfill. The support zone was maintained in a small area around the field office (See Figure 2-1).

2.2.2 Power pole Management

Two KCP&L power poles were located in the area of the Railroad Avenue excavation. The excavation would not be possible with the power poles present. The power lines were the end of a service leg that only served the NS railyard. A plan was developed with KCP&L and NS to remove the two power poles and to permanently relocate the power lines on a route that completely avoided the areas where the RA was begin conducted. The relocation plan was successfully implemented without interfering with the NS operations. The locations of where the poles were once located and the new permanent route are shown on Figure 2-1.

2.2.3 Miscellaneous Debris

The Site, including the Railroad Avenue and Sutherlands work areas were open land. The City of North Kansas City had removed the Sutherlands building and portion of the asphalt pavement at the entrance from Armour Road and Vernon Avenue. Asphalt remained around the footprint of the building. To prepare for the RA miscellaneous debris including vegetation and a narrow asphalt area remaining along the boundary between the Sutherlands and HABCO parcels was removed. The location where the removed vegetation and asphalt was present is shown on Figure 2-1. The vegetation was disposed at the Courtney Ridge Landfill. The asphalt was sent to Obermeyer Reclaim in Independence Missouri for recycling.

2.2.4 Temporary Access and Railroad Avenue

The Railroad Avenue RA required the complete closure and removal of roughly half of Railroad Avenue. The road was demolished and the materials were sent to Obermeyer Reclaim. Railroad Avenue was the only access to the NS railyard. To provide access to the railyard while the Railroad Avenue RA was being conducted a temporary road was built from the signalized intersection of Armour Road and Vernon Avenue to the railroad crossing. The location of the temporary access road is shown on Figure 2-1.

The temporary road was paved and fencing was installed on both sides of the road to prevent public access into the exclusion zones of the RA work areas. The design of the temporary road was approved by MODOT as was the coordination of the Railroad Avenue road closure and changes to turn lanes on Armour Road. The MODOT permit is provided in Appendix A.

After the Railroad Avenue RA was completed and Railroad Avenue was replaced the temporary road was removed. The pavement was sent off-Site to Obermeyer Reclaim for recycling. Roughly 1,347.5 tons of concrete and asphalt from Railroad Avenue, the demolition of the temporary road, and the narrow asphalt strip described above were hauled off the Site for recycling. A letter certifying the transportation of demolition debris to Obermeyer Reclaim is provided in Appendix B. The road base from the temporary road, being clean rock, was used as backfill in the RA excavation.

The reconstruction of Railroad Avenue was done according to an alignment and design provided by NKC. The new alignment and design made the new road compatible with the City's larger redevelopment and transportation plans for the entire area south of Armour Road from Interstate 29/35 to the intersection or Armour Road and Railroad Avenue. The new road design was approved by MODOT. MODOT also approved several short term bypass lanes the Respondent had to construct to maintain access to the NS railyard as the construction and traffic patterns transitioned from the temporary road to the new road at the track crossing. Norfolk Southern was kept informed at all stages of the changes to their access pattern. The access work was completed without any interruption to the NS operations.

2.2.5 Relocation of water supply line

A 10" diameter municipal water pipe ran through the Railroad Avenue RA work area. The RA could not be conducted with the water pipe present. The Respondent coordinated with NKC to conduct a pipe shut down test to determine if the service through the pipe could be could shut down while the RA was begin conducted. The shut-down test showed that there was sufficient pressure and flow in the service region through other service routes when the pipe was shut down. A valve exists on the pipe segment along Armour Road. A plan was coordinated with the City were the Respondent would install a hot-tap valve in the water pipe where the pipe headed under the BNSF and NS tracks. The new valve, along with the exiting valve allowed for the Railroad Avenue pipe segment to be isolated, shut down, and removed without interrupting the municipal water service.

The pipe isolation plan was implemented and the pipe segment in the Railroad Avenue RA area was removed (See Figure 2-1). When the RA was completed in the Railroad Avenue area the water pipe was replaced. The pipe was replaced with 10" ductal iron pipe with bell and spigot fittings. Angled fittings were connected with bolted flanges. All angled turns were reinforced with concrete thrust blocks.

Once the water pipe was placed the system was chlorinated, the water was tested, and when the tests were passed by the City, the pipe was put back into service. The results of the testing done by the City are provided in Appendix C.

2.2.6 Storm Sewer Protection, Removal, and Replacement

Several active storm sewers were present in the RA work areas. These sewers were protected with silt fencing and straw bales. The locations of the sewers are shown on Figure 2-1. A 72" diameter storm sewer was located under and parallel to Railroad Avenue. This storm sewer had to be removed to conduct the RA. As the excavation progressed the 72" storm sewer was plugged at the upstream and downstream ends to prevent the flow of storm water into the excavation. The storm sewer was completely removed and was sent off-site to Obermeyer Reclaim.

When the Railroad Avenue RA was complete and the excavation was being backfilled approximately 240 feet of 72"storm sewer was replaced with new reinforced concrete pipe (RCP). The RCP was delivered in 72" diameter by 8 foot long sections. The pipes were fitted with rubber gaskets. The trace of the pipe was placed slightly to the north of the original trace and was extended an addition 90 feet to the west (for a total reinstalled length of approximately 330 feet) to accommodate the long-term storm water management plan developed by NKC for the entire redevelopment area.

The 72" RCP was installed according to the *"Armour Road Redevelopment Railroad Avenue"* design by Olsson and Associates as revised September 27, 2016. The design called for relocating the road storm drains from the pre-RA locations to locations suited to the long-term replacement of the portions of Railroad Avenue that were not removed during the RA. The new storm drains required pre-cast drop inlets, 15" and 24" laterals, and a connector box and manhole that could accommodate the connection of the old and new 72" RCP and the 15" and 24" laterals.

The installation of the 72" pipe and laterals, the drop inlets, and the connector box followed MODOT specifications in Section 600, 724 and 726 of the Missouri *"Standard Plans for Highway Construction"*. Pipes were connected following the MODOT Section 724 "soil tight fittings" specification. Relevant American Association of State Highway and Transportation Officials (AASHTO) and ASTM requirements were followed. The pipe was provided by Forterra. The Forterra guidelines for allowed pipe pull and deflection were followed. A section of the 24' lateral to the connector box had excess defection and pull that could not be rectified in the field so a concrete collar was poured around the entire joint. A photographic record of the collar pour is provided in Section 6.

2.3 CLEANUP GOALS

A principal administrative step was establishing clean-up goals for the RA. This Subsection provides a broad overview of the goals, practical limitations to the goals, and how the goals were met during the excavation. Details of the excavation and specific details of achieving the goals are provided in Section 3.0.

The clean-up goal is performance based. All arsenic-contaminated soil was to be removed when practical, safe, and cost effective. Excavated soil with an aggregate average arsenic concentration of less than 70 mg/kg was placed back in the excavation. Where soil was excavated the upper 5 feet of soil backfill was specified as clean imported backfill.

The goal to remove the maximum mass of arsenic-contaminated soil as technically feasible was dependent upon the stability of the side slopes of the excavation, the water table, and the adjacent railroad. Considering these physical boundaries it was understood that some soil containing arsenic would remain at the Site when it was not feasible to continue the excavation. Given that a very large percentage of the arsenic mass would be removed, the potential threat to groundwater quality would be mitigated to the maximum extent practical. The only remaining potential risk would be to utility workers that may work at the periphery of the backfilled RA excavation during the development of the property in the future.

The goals for the RA were met by excavating soil to the maximum depth and lateral limits possible without creating unsafe work conditions. The arsenic was present in migration filaments and layers and not a large mass. The filaments were removed laterally and vertically until the filaments became thin and were overlain by many thousands of tons of soil that did not require excavation to meet the clean-up goals.

As was stated in the Introduction and will be documented in detail in the next Section, significant remnants of historical industrial operations were found at depth on the Sutherlands parcel. Concrete foundations on piers where large industrial structures once stood and a sump were discovered. High arsenic concentrations as well as high concentrations of copper which stained the soil bright green, iron that stained soil red, black char, and a tar substance were found in close association with these structures. The structures were removed by the Respondent to access other areas of the Sutherlands parcel that were the target of the RA under the CD.

As the extent of the arsenic in the excavation was monitored in real time with the XRF the extent of migration from the HABCO parcel was defined and contamination was removed. Contamination from the historical industrial operations on the Sutherlands Parcel continued to the west of the Sutherlands Parcel RA. The remaining Sutherlands-related contamination is discussed in detail in the next Section.

3.0 EXCAVATION, TREATMENT, DISPOSAL, BACKFILL

This Section documents in detail the soil excavation, testing, treatment, disposal, and backfill components of the RA. The nature of the contamination discovered, the type of equipment used, the stockpiling and sampling techniques, analytical data, estimates of the arsenic mass removed, drawings of the arsenic left in place, and the discovery of past industrial operations on the Sutherlands parcel are documented.

3.1 EQUIPMENT USED

The excavation aspect of the RA was a process of excavating soil with a track mounted excavator and creating an interim stockpile near the excavation. A rubber tire loader was used to transfer the soil from the interim stockpile to the soil staging areas where the soil was tested for its arsenic concentration. There were two soil staging areas, one for each RA parcel (See Figure 3-1). The Railroad Avenue soil staging area was in the center of the HABCO Site. This area was open grass. A loop road of rock was built around the staging area. Trucks entered and departed via a portion of Railroad Avenue that was not included in the RA. The Sutherlands Parcel RA soil staging area was located to the west of the excavation area. Most of the staging area was on asphalt paving. Trucks entered and exited via Armour Road.

Once decisions were made on the disposition of the soil the loader was used to move soil that could be used as backfill back into the excavation. The loader was used to load trucks with soil that was disposed at the Courtney Ridge Landfill. When soil required treatment the excavator was used to add Enviroblend® to the soil and to mix soil with the Enviroblend®. The loaded was used to further mix the soil and Enviroblend® as the soil piles were moved and loaded onto trucks.

As backfill was placed the loader was used to spread and compact imported soil used to backfill the excavation. A small skid-steer Bobcat was used to spread rock, finely grade small areas, and to scrape dirt off of paved surfaces. A broom attachment was used on the Bobcat to sweep road surfaces. Specific details of the how the equipment was used to excavate, stockpile, load and backfill are provided later in this report.

3.2 WORK ZONES

The following three work zones were established at the Site:

1) Exclusion Zone,
2) Contaminant Reduction Zone, and
3) Support Zone.

The work zone locations are shown on Figure 3-1.

3.2.1 Exclusion Zone

The Exclusion Zone encompassed the entire two RA parcels and was surrounded by a 6-foot-high chain link fence. Vehicle gates were kept closed and locked when not in use. For short term inactivity the vehicle gates were taped off with caution tape. All visitor traffic was directed to the office where personnel access was controlled. Only authorized project personnel with appropriate safety training were allowed within the Exclusion Zone.

3.2.2 Contaminant Reduction Zone

The Contaminant Reduction Zone (CRZ) consisted personnel decontamination areas which were located at the entry to the support zone. The CRZ consisted of a boot washing station. Work was done in Level D Personal Protective Equipment (PPE) so a donning and doffing station was not needed.

The CRZ for equipment was located within the exclusion zone at points of exit and entry. Rumble plates were placed on the ground to knock dirt off truck tires before the truck left the Site. Every truck was inspected for loose dirt and a secure cover before the truck left the Site.

3.2.3 Support Zone

The Support Zone was set up in the immediate area of the field office. The Support Zone consisted primarily of the field office and the parking area. The office, and thus the Support Zone, was located within the fenced area for security. The Support Zone work area was utilized by Rio Tinto, the USEPA, AMEC, AIS, and visitors.

The support zone was separated from the exclusion zone by cones and caution tape. Specific points of personnel entry and exit from the support zone were established to maintain an orderly path for foot traffic, and to separate foot traffic from vehicular traffic.

3.3 AIR MONITORING

An air-monitoring program was implemented to ensure protection of both the general public and Site workers during the cleanup activities. In general, the air-monitoring program included the following elements:

- General work zone dust and organic vapor monitoring;
- Worker dust exposure monitoring; and
- Testing before and during confined space entry.

3.3.1 General Work Zone and Organic Vapor Monitoring

General air monitoring was conducted during the excavation of potentially contaminated soil and the handling of that soil on-Site. The results of the Direct Reading Instrument (DRI) were used to screen for the presence of potential chemical or physical hazards. A DataRAM pDR-1000AN Monitor was used to monitor real-time emissions of dust, smoke, mists, and fumes. The DataRAM pDR- 1000AN Monitor provides a digital readout of the aerosol and dust concentrations of particles sized between 0.1 and 10 micrometers (μm) at a concentration range of 0.01 to 100 mg/m^3 (±0.02 mg/m^3). When soil was being excavated the instrument was place where soil was temporarily stockpiled after being excavated and then moved via the loader to the soil staging areas. This interim staging area was where soil was moved the most over a short period of time and thus would be expected to produce the highest dust emissions.

The DataRAM has an internal factory calibration. Each morning the instrument was zeroed as the daily calibration. The daily average detected dust concentrations ranged from 0.001 to 0.118 mg/m^3 (See Appendix D). The response action standard established in the HASP for total arsenic concentrations allowable in the ambient air was single dust concentration of 0.5 mg/m3. No single value exceeded this standard. The standard was based on the maximum known on-site arsenic concentration of 16,000 mg/Kg of arsenic in soil which was assumed to be present as a bulk mass. Though higher arsenic concentrations were found during the RA the higher concentrations were not present as a large mass of contaminant, but as filaments of arsenic in a larger mass of much less contaminated soil. Therefore the actual arsenic concentration in the dust is projected to be lower than what was factored into the standard established in the HASP.

An organic vapor detector was used from to time when odors were noticed. No unusual concentrations of organic vapors were detected.

3.3.2 Worker Monitoring

Workers were monitored for particulate concentrations within their work zone according to the NIOSH protocol using medium-flow personal air monitoring pumps calibrated to approximately 2.0 liters per minute and connected to a 5 micron Teflon filter. Air monitoring pumps were calibrated to an airflow rate in accordance with the sample method protocols both before and after sampling with a primary standard. Pumps were equipped with appropriate sampling media in a sampling train, and filter cassettes were attached to the worker's lapel on the right or left shoulder, within the breathing zone.

The calibration flow rates were used to calculate final sample volumes from the total elapsed sampling times. Samples remained under AMEC Foster Wheeler control until delivered to the analytical laboratory. Samples were sealed, documented, and delivered to Pace Laboratories located in Olathe, Kansas. The Pace is accredited by the American Industrial Hygiene Association (AIHA) for analysis of samples by approved OSHA and NIOSH methods 0600 and 7500. Canisters were analyzed for arsenic. Iron and magnesium were added to the testing in January when work was being conducted on the Sutherlands parcel and high iron and magnesium concentrations in the soil were revealed by the XRF.

The worker action-level standard for arsenic was set at 5µg/m^3; the PEL is 10 µg/m^3. The PEL for iron and magnesium is 15,000 µg/m^3 of arsenic per cubic meter of air. The time weighted average for all personal monitoring results were all below the Action Levels and PELs (See Appendix E).

3.3.3 Confined Space Entry

Connecting the storm water pipes to the connector box required formal confined space entry procedures, which were implemented. Before entry into the confined space the work area was tested for oxygen concentration, organic vapors, and flammability/explosion potential. The work area was well ventilated so all confined space entry readings were within the parameters for safe entry. Monitoring continued while workers were in the confined space.

3.3.2 Dust Control Measures

Notwithstanding the dust measurements from real time monitoring, dust was suppressed when it was visually noticed. Dust suppression techniques included watering traffic areas within the boundaries of the Site, sweeping paved areas on the Site, and sweeping the public roads off the Site. Dust suppression was done when dust was observed.

3.4 EXCAVATION OVERSIGHT AND MANAGEMENT

This Section provides a broad overview of the procedures and process used to document the execution of the RA and to ensure that the program objectives were met. A brief overview of the documentation procedures is provided followed by details of the following:

- The instruments used to gather data;
- The steps taken to gather real-time data to guide the excavation;
- How soil piles were created and managed;
- How the need for treatment of the soil was determined and how treatment was performed and documented;
- How the soil was hauled off the Site and disposed; and

3.4.1 Program Overview

A disciplined program was implemented to monitor and document each step of the excavation. An XRF was used to field analyze soil for arsenic and select samples were analyzed in a laboratory to confirm the accuracy of the XRF. Generally the samples with the highest arsenic concentrations as determined by the XRF were sent for laboratory confirmation. Pace Analytical Services of Lenexa, Kansas (Kansas/NELAP Certification #: E-10116 and Kansas Field Laboratory Accreditation: # E-92587)was used for the laboratory analyses. The XRF was calibrated daily using standards provided by the manufacturer. Laboratory data and XRF data were compared to monitor the accuracy of the XRF field testing procedures. The decisions made on soil pile management were made using both the XRF and laboratory data.

In-situ arsenic contamination was documented with the XRF to guide the excavations along sidewalls and bases, and to direct further excavation, where possible, to maximize mass removal. The measured arsenic concentrations were painted on the sidewalls and base to direct the excavation and to document the final conditions. The residual arsenic left in place was documented with XRF measurements on a grid pattern; the grid was mapped in the field notes, and confirmation samples were collected and analyzed in the laboratory for total arsenic.

Soil piles were created by the contractor, American Integrated Services. As the piles were being created the soil was sampled. Each pile was assigned a number to provide a tracking identity. The quantity of soil samples collected per pile was based on the approximate volume of soil in each pile. The soil piles were typically 200 tons each. Approximately 70 to 100 individual samples were collected from each pile and composited into approximately seven (7) to ten (10) distinct samples for testing with the XRF. As described above, selected soil samples (typically the two (2) samples with the highest arsenic concentrations) were analyzed by the laboratory for total arsenic and/or TCLP arsenic.

Field XRF data and laboratory data were reviewed to determine and direct disposition of the soil piles. Depending upon the arsenic concentrations the soil was managed as follows:

- For use as backfill;
- Being sent to the landfill; or
- Requiring treatment before being sent to the landfill.

When the average arsenic concentration in a pile was less than 70 mg/kg the soil was used as backfill. When arsenic concentrations were less than 500 mg/kg the soil was sent directly to the landfill. When arsenic concentrations exceeded 500 mg/kg the decision to send the soil to the landfill or to treat the soil first was made based on the TCLP results. Soil that exceeded a leachable arsenic concentration of 5 mg/L was treated before being disposed at the landfill. The success of the treatment process to reduce the leachable arsenic concentration to below 5 mg/L was documented.

When treatment was needed the treatment dose was based on TCLP arsenic results. Higher TCLP results required a higher dosage for treatment. Post-treatment the soil piles were resampled, and two soil samples per pile were analyzed for total arsenic and TCLP. Once the TCLP was below 5 mg/L the soil was disposed off-Site at the Courtney Ridge Landfill.

3.4.2 Detailed Documentation of Sample Testing.

This section provides details of the sample testing procedures.

Instrumentation and Laboratory

The XRFs were calibrated daily for arsenic using standard calibration cartridges (RCRA, NIST, SiO2). The instruments were only used when they passed the calibration checks. Soil samples that were sent to the laboratory for analysis were packed in ice in a cooler with a chain of custody and custody seal. The samples were picked up daily from the Site by a Pace representative and delivered to the Pace Analytical laboratory in Lenexa, Kansas. All samples were analyzed for total arsenic following method SW846 6010. When the total concentrations of arsenic as measured by the XRF suggested the possibility of an elevated TCLP the samples were also analyzed for TCLP using method SW846 6010 coupled with sample preparation method 3010. The laboratory data reports are provide in Appendix F.

Laboratory results were compared to XRF data and a linear regression comparing the data was regularly calculated through the program. The regression analysis was done periodically throughout the RA to determine if a change in procedures was needed.

XRF data was tabulated daily for each soil pile (See Appendix G). Corresponding laboratory data for the pile was recorded on the XRF Table opposite the corresponding XRF reading. The nature of the contamination became a complicating factor when directly comparing the XRF and laboratory results. The highest arsenic concentrations were present as filaments and not as a bulk mass; however, the soil piles were created as a bulk mass of soil. Comparing the accuracy of the XRF method to laboratory confirmations is predicated on both analytical techniques measuring the same soil. Though the excavation and soil pile creation process thoroughly mixed the bulk soil with the filaments of contamination, both the XRF and laboratory testing techniques use aliquots of soil. An aliquot can he highly skewed from the overall characteristics of a soil pile if the aliquot has a small fraction of a filament.

After reviewing the XRF and laboratory data sets it became evident that there were a small percentage of significant outlier data points that skewed the regression analysis. Overall about eight percent (8%) of the data were outliers that are a result of the aliquot characteristics and not differing accuracy of the XRF and laboratory analytical techniques.

Four regression assessments were run. These assessments were:

- Regression using all data;
- Regression excluding outliers;

- Regression for XRF results less than 500 mg/kg, excluding outliers; and
- Regression for XRF results less than 1,000 mg/kg, excluding outliers.

The results of each of these assessments are provided below.

Regression using all data and excluding outliers – The regression assessment using all 676 data points resulted in a regression coefficient of 0.58 which is below the target of 0.7. The regression plot with all data is shown on Figure 3-2. The presence of significant outliers is evident on the figure. The lower than targeted correlation is due to the aliquot variations.

When the 44 outliers were removed, leaving 632 data points, the correlation coefficient increased to 0.76 which meets the project objective. The regression plot with the 632 data points is shown on Figure 3-3. The tight correlation is evident on the figure.

Regression for XRF results less than 500 mg/kg – The regression analysis done for arsenic concentrations less than 500 mg/kg, as measured with the XRF, is shown on Figure 3-4. On this figure, and in the regression analysis, 421 data points are used, and 37 data points were excluded as outliers. The correlation coefficient for data less than 500 mg/kg is 0.74.

Regression for XRF results less than 1,000 mg/kg – The regression analysis done for arsenic concentrations less than 1,000 mg/kg, as measured with the XRF, is shown on Figure 3-5. On this figure, and in the regression analysis, 504 data points are used, and 49 data points were excluded as outliers. The correlation coefficient for data less than 1,000 mg/kg is 0.74.

The purpose of the XRF screening was to select samples for testing soil samples in the laboratory and for making disposal decisions for soil with concentrations less than 500 mg/kg. The protocol was to send sample with the highest XRF readings to the lab for confirmations. Samples with the highest XRF readings were most likely to have residual filaments; therefore, the protocol was effective in identifying samples that were most likely to have the most aliquot variability. By lab analyzing the samples with the most potential for variability, secondary confirmation on the potentially highest arsenic concentrations was obtained and proper decisions were made on treating and disposing of the soil.

Laboratory Data Quality Assessment

The data Quality Assurance and Quality Control (QA/QC) was comprised of multiple components. Quality Assurance was achieved by Pace Analytical Labs having established sample management, processing, calibration, work review, and reporting procedures. The field work was coordinated with the Pace procedures by daily work flow communication and sample chain-of-custody (COC) records. When samples were received by Pace they checked the integrity of the samples and the COC, assured the proper labeling of the samples compared to the COC, the internal temperature of the cooler containing the samples was recorded, and the lab compared the analytical instructions on the COC to the project specifications.

Quality Control was achieved through a series of laboratory analyses that included the following tests:

- Laboratory Blanks;
- Laboratory Control Spikes;
- Matrix Spikes and Matrix Spike Duplicates (MS/MSD) and calculating the relative percent difference (RPD);
- Surrogate analyses;
- Duplicate analyses of field samples; and
- Measuring the sample temperature at the time of analysis.

Data Quality Assessment and Exceptions

Of the Quality Control process the Laboratory Blanks; Laboratory Control Spikes; and Surrogate analyses all met the specifications; only the MS/MSD tests and some pre-analysis TCLP sample temperature excursions were noted. Of the four months of analytical work 47 MS and or MSD analyses showed spike recoveries out of the target range. A few of these MS/MSD analyses also showed RPDs that did not achieve the target range. Of these 47 MS/MSDs 39 of them were low concentration spikes into samples containing high arsenic concentrations. Therefore, the existing high arsenic concentration in the sample masked the spike. Of the remaining 8 MS/MSDs that did not achieve the target recovery, the recovery was only a few points out of the desired range.

MS/MSD tests of native samples are difficult due to complex chemistry within the sample that can mask spikes, and the clay nature of the soil that can make fully blending the spikes with the matrix difficult. All of the Laboratory Control Spikes for the entire analytical program met the recovery specifications confirming that the laboratory instrumentation was operating within specifications. Given that only 8 MS/MSD recoveries could be attributed to the matrix, and that the recoveries were only slightly out of the target range, the MS/MSD results are considered typical and do not affect the use of the data for its intended purposes.

Eighteen (18) field duplicate soil samples were delivered to the laboratory for analysis. The RPDs for these samples ranged from 0.93% to 161.41% (See Table 3-1). Duplicate analyses of soil sample generally have a broad range of RPDs due to the sample variability of aliquots and an inhomogeneous distribution of the contamination within the sample matrix. The inhomogeneity of samples at this Site was compounded by the thin filament-like migration pattern of the arsenic migration. The relatively tight RPD distribution among the duplicate samples indicates that the sample homogenization process used the combine the individual excavated soil pile samples collected to form the laboratory samples was thorough and the inherent field variation of samples is not a factor in the soil disposal decisions made. None of the field decisions made would have been affected whether we used the lower or the higher value of each duplicate result.

Twenty one samples batches showed pre-analysis temperatures that were not within the target temperature range. The laboratory was asked about the temperatures and how they could affect the results. Their response is found in the preface to the Laboratory Reports in Appendix F. The Laboratory reported that arsenic solubility and extractability is much more dependent upon pH conditions than it is on temperature conditions. Though pH is temperature dependent, at the pH of the buffer used, a slightly out of target lower temperature has minimal effect on the pH. There is limited data validation guidance for TCLP data review from the TCLP extraction. The US EPA evaluated the procedure for ruggedness, and pH was clearly the major factor, whereas temperature was not evaluated as a variable; *SW-846 Method 1311, Rev. 0, July 1992"*. The State of Ohio has published guidelines in their "Tier I Data Validation Manual for the Division of Hazardous Waste Management, June 13, 2011". Page 122, Section 5.1.9 offers the following on the topic of "Was the room temperature during the extraction 23^{o}C ±2oC"; *Data would not be rejected using this criterion except in extreme cases (e.g., very cold temperature with detectable TCLP compounds"*. Given that the TCLP method is most dependent upon pH changes, the method requires that the extraction fluids be prepared so that the final pH is within + 0.05 units as specified." For the RA project the extraction fluid final pH was prepared properly for all samples and was within the 0.05 units as specified. Based on the QA/QA assessment the temperature variation did not affect the data quality the project achieved 100% data usability.

3.4.3 Monitoring In-Situ Conditions During the Excavation

During the excavation arsenic concentrations in the excavation area were measured with an XRF; the concentrations detected were displayed on excavation sidewalls and base with spray paint. Further excavation was directed based on lateral and vertical arsenic contamination trends. The process of testing in-situ, excavating, and retesting in-situ continued until the lateral and vertical limits of the excavation were reached.

The in-situ testing followed a biased and an unbiased approach. The biased approach was focused on testing areas of arsenic contamination that were known to be elevated due to the visual characteristics of the contamination. Early in the excavation it became evident that the areas of elevated arsenic contamination had a strong a visual cue. The arsenic was bright yellow and orange and was often found in streaks, beds, and filaments. The arsenic had a strong affinity for organic substances, especially wood. The biased testing was done directly on the yellow staining to estimate the arsenic concentration extent of the highest arsenic concentrations, some of which approached 40,000 mg/kg.

Biased sampling was also done on the unstained soil surrounding the bright yellow and orange areas. The bias testing around the high concentrations was done to determine if the observable contamination created a larger mass of soil that had high arsenic concentrations, but did not reveal the visible staining. When large masses of stained soil or a mass of surrounding unstained of soil with very high arsenic concentrations was discovered, the soil was often treated in-situ before being excavated because it was self-evident that the soil required treatment.

The unbiased XRF testing in-situ was done on a grid without a preference for any areas of visible contamination. The grid was used to define the arsenic contamination in the broader areas of excavation.

3.4.4 Creating and Managing Soil Piles

Soil was excavated and stockpiled to be sampled in the designated soil staging areas. Each soil pile typically contained approximately 200 tons of soil. Each pile was assigned a number to provide a tracking identity. The numbers were affixed to the piles with numbered flags and by painting the number on the soil. Soil samples were collected from each pile based on the size of the soil piles (generally 200 tons). From each 200 ton soil pile, 70 to 100 aliquots were collected and then homogenized in a five-gallon bucket. Following homogenization, the soil was divided into quart-sized plastic bags and screened with an XRF. Roughly seven (7) to ten (10) bags of soil were formed for each pile. At least two XRF readings were taken per plastic bag. The XRF readings from each bag for each pile were averaged to determine an average arsenic concentration for the entire pile. The arsenic concentrations measured were recorded in the field notes and regularly tabulated for comparison to the laboratory results.

The XRF and laboratory results were also used to direct the disposal decisions for each soil pile. Piles with XRF measured arsenic concentrations that averaged less than 500 mg/kg arsenic did not require TCLP arsenic laboratory confirmation prior to landfill disposal because it was known, from past experience during the 2006 RA, and during studies from the RI, that when the total arsenic concentrations were less than 500 mg/kg the soil also passed the TCLP requirements.

There were circumstances when the average soil pile arsenic concentration was less than 500 mg/kg, but there were outlier concentrations in a few of the bags that were nearing 1,000 mg/kg. In these cases with outliers within a pile, and when the average XRF measurement within a pile exceeded 1,000 ppm arsenic, soil samples were sent to the laboratory for TCLP arsenic analyses. Generally, the two samples with the highest arsenic concentrations determined by the XRF were sent to the laboratory and were analyzed for total arsenic and TCLP arsenic. Regardless of the concentration, at least one sample per soil pile was analyzed by the laboratory for total arsenic to provide a comparative concentration to assess the accuracy of the XRF.

Laboratory results and the XRF data were reviewed to direct the disposition of the soil. Soil samples exceeding 5 mg/kg for TCLP arsenic required treatment prior to being sent to the landfill. For any pile that was treated the post-treated soil piles were resampled. Post treatment soil samples were analyzed in the laboratory for TCLP arsenic concentrations to confirm the soil was treated adequately to reduce TCLP arsenic concentrations to below 5 mg/L. If post treatment soil concentrations still exceeded 5 mg/L TCLP arsenic, retreatment and resampling was required to reach acceptable TCLP arsenic levels for landfill disposal. Soil piles with laboratory TCLP arsenic results below 5 mg/L were directed for landfill disposal without treatment. Details of how the soil was treated are provided below.

3.4.5 Treatment of Soil

A treatment product called EnviroBlend®, provided by Premier Magnesia, was used at the Armour Road Site to treat soil and render it non-hazardous. EnviroBlend® was used on all soil where the leachable concentration of arsenic in the TCLP exceeded the regulatory limit of 5 mg/L. Soil containing leachable arsenic concentrations above this regulatory limit are classified as hazardous in accordance with the Resource Conservation and Recovery Act (RCRA) of 1976.

Effectiveness Testing

EnviroBlend® was shown to be effective at preventing the leaching of arsenic from the soil found at the Armour Road Site. Before the treatment chemical was selected for use at the Site, a bench-scale treatability study was done to document its effectiveness. Samples of soil from along Railroad Avenue which were known to contain concentrations of arsenic up to 16,000 mg/kg and leachable arsenic exceeding 20 mg/L were collected from the Site. The samples were analyzed for total and leachable arsenic before being treated with EnviroBlend®. After the initial characterization, EnviroBlend® was applied to the samples at different doses to determine the optimal dose that reduces the leachable arsenic concentration to below 5 mg/L. The samples with the optimal dose were subjected to an analytical regiment called the Multiple Extraction Procedure (MEP). This is a USEPA protocol whereby the treated samples are subjected to ten sequential extractions and the extract is analyzed for arsenic. The ten extractions are designed to simulate the leaching of arsenic from the soil in a landfill/acid rain environment over a period of 1,000 years. For the treatment chemical to be deemed effective in meeting the MEP criterion, the extract arsenic concentrations at the end of the extraction sequence must show a diminishing trend in the concentration of leachable arsenic. The EnviroBlend® treated soil met this criterion. The results of the MEP testing are provided in the "*Final Work Plan Addendum – Work to complete the Feasibility Study*", November 30, 2015.

How EnviroBlend® Works

Arsenic commonly exists in soil in several chemical forms; the form depends on the conditions in the soil. These different forms have varying mobility, ranging from highly mobile to immobile. Two major factors control the mobility; one factor is how oxygenated the soil is, and the other is the pH of the soil. Under low oxygenated conditions, arsenic occurs as arsenite which is generally more mobile than arsenate, which is found in an oxygen-rich environment. The key to immobilize the arsenic is to convert it to an insoluble arsenate form and to establish a soil environment in which the arsenate is highly stable. Iron (in the ferric form) is particularly effective in forming insoluble and immobile arsenate compounds. Additionally, arsenate is least mobile when the soil pH is near neutral.

EnviroBlend® achieves these objectives through a threefold process. First, EnviroBlend® contains a ferric sulfate product which has 100% of the ferric ions available for the chemical reactions that immobilize the arsenic. As the EnviroBlend® is mixed with the soil, the ferric sulfate dissociates into ferric and sulfate ions. The ferric ions react with the moisture in the soil to form ferric hydroxide which subsequently absorbs arsenic from the soil creating an insoluble complex. This complex is the first step in the precipitation of ferric arsenate. The ferric hydroxide continues to react with the adsorbed arsenic complex and arsenic in the soil to form ferric arsenate.

The chemical reactions are promoted by oxygenating by mixing the soil. The adsorption process and the creation of ferric arsenate in the oxygenated soil are the primary processes by which the arsenic in the soil is stabilized and rendered non-hazardous. Another significant benefit of the use of EnviroBlend® to treat the soil from the Site is that the treatment chemicals provide more ferric ions than needed to simply meet the TCLP. The ferric sulfate in the EnviroBlend® remains mixed with the soil wherever it is placed. In this case the soil was sent to the Courtney Ridge landfill. Should any residual arsenic leach from the soil after being placed in the landfill, the EnviroBlend® will immediately stabilize the arsenic via the processes described above.

Dose

The dose of EnviroBlend® for the Armour Road Site was determined by the bench-scale study on representative soil samples from the Site. The conclusion of the study was that a dose of approximately six percent EnviroBlend®, relative to the mass of soil being treated, was needed to immobilize the arsenic concentrations found at the Site. The specific dose depends upon the concentration of arsenic in the soil, with the higher doses applied to soil with the higher arsenic concentrations. The long-term effectiveness of the dose and ratio were confirmed through the MEP lab tests prior to the start of the Site work.

During the excavation work the nature of the arsenic migration pattern was different that initially thought. The initial thought was that the arsenic was present as a mass in soil and that the arsenic concentrations feathered out from the center of mass to lower concentrations along the edges of the mass. The excavation revealed that the arsenic migration pattern was along distinct channels of very high arsenic concentrations (nearing 40,000 mg/kg) in a soil matrix that has arsenic concentrations an order of magnitude and more less that the concentrations in the migration channels. The EnviroBlend® dose was based on an arsenic mass, and not distinct channeling that was blended with the surrounding soil as it was excavated. The dose was adjusted through experimentation in the field. A dose of one to two tons of EnviroBlend® per 100 tons of soil was found to be effective for the blended soil that formed the piles.

Treatment and Mixing

Treatment and mixing was done in-situ at times, and in soil piles staged above ground.   As will be described in the next Section the arsenic was easily identified by zones of bright yellow and orange staining and grit in the soil. The yellow/orange substance contained arsenic at concentrations well exceeding 10,000 mg/kg up to concentrations approaching 40,000 mg/kg. The TCLP concentrations of the yellow/orange substance were over 20 mg/L. When large areas of the yellow/orange substance were noted in-situ the soil was treated in-situ since it was known to fail the TCLP.   EnviroBlend® was spread over the soil at a rate of approximately one ton per 100 tons of soil. The excavator was used to mix the soil and the EnviroBlend®. An interim staging pile of the treated and mixed soil was placed at the top of the excavation where the loader was used to move the soil to the soil staging area. The act of moving the soil a second time with the loader further mixed the soil with the Enviroblend®.

Treatment of ex-situ soil piles was done by mixing EnviroBlend® into measured quantities of soil (typically 200-ton piles). The amount of EnviroBlend® added to the piles was based on the results of the treatment study and performance experience gained during the RA. To ensure the EnviroBlend® was thoroughly mixed into the soil, each treated soil pile was mixed five to six turns with an excavator.

3.4.6 Off-haul and Disposal

Once an off-haul decision was made for each soil pile the soil was loaded into trucks using the rubber-tired loader. Tom Peace Tucking, a licensed hauler (DOT license number 345833) was used to haul the soil. Each truck was completely filled with soil and the transport cover was deployed covering the contents of the truck. The trucks were inspected for loose dirt, secure latches, and the function/security of the contents cover. Any truck that did not pass the inspection was not allowed to leave the Site with dirt. A manifest was completed for each truck load of dirt. The generator's copy was detached and the remaining manifest accompanied the truck to the Courtney Ridge landfill. As the trucks left the Site rumble grates were used to knock off any dirt that may have clung to the wheels and sides of the truck.

Upon arriving at the landfill the manifests were checked, the truck was weighed, and the driver was directed to the area of the landfill in use at the time. Upon leaving landfill each truck was reweighed to determine the tonnage of soil delivered to the landfill in the particular truck load. A similar process was followed for the off-haul and recycling of concrete and asphalt.

Disposal records were kept at the landfill and at the Site and were reconciled at the conclusion of the project. All trucks were accounted for and a letter certifying the tons of soil delivered was issued by the landfill. A letter certifying the tons of concrete and asphalt delivered to the recycler was issued by Tom Peace Trucking. The certification letters are provided in Appendix H and the manifests are provided in Appendix I.

3.5 EXECUTION STAGES OF THE RA

The RA was divided into the two excavation parcels shown on Figure 3-6. The excavation work began on the Railroad Avenue Parcel. Work did not progress to the Sutherlands Parcel until the Railroad Avenue area was backfilled to grade.

Work elements common to both the Railroad Avenue area and the Sutherlands parcel are as follows:

- Soil was not disposed until analytical testing data documenting that the soil met regulatory acceptance criteria was received.
- The waste profile was continuously kept current with the landfill.
- Following landfill approval of the disposal decision, the soil was loaded into trucks.
- A uniform non-hazardous waste manifest was filled out and signed for each truck. The manifest included the generator’s name and address, Site address, waste description, waste code, transporter information and disposal facility information.
- A tarp was placed over the truck bed and secured.

Each work area is discussed below.

3.5.1 Railroad Avenue Excavation

The Railroad Avenue RA began the week of September 24th 2016 and ended November 8, 2016. The excavation began at the eastern end of the work area and progressed to the west. As described above in Section 2.0 the municipal water pipe and the storm sewer pipe were removed as they were encountered. Real-time in-situ testing of soil was done as described above to guide the excavation and segregate soil into piles which were projected to have roughly equal concentrations of arsenic (i.e. low concentrations grouped alone, mid-range concentrations grouped, and high concentrations grouped).

The layout of the excavation is shown on Figure 3-7. Figure 3-7 shows the original planned excavation based on the RI and the limits of the excavation actually conducted. The excavation extended from a point to the east where arsenic concentrations in native soil were approximately 400 mg/kg to the west into clean fill that was placed during the RA completed in 2006. The excavation extended to the north until the 2006 RA clean fill was exposed. To the south, the excavation continued as far as possible while maintaining stable side walls in the excavation adjacent to the BNSF railroad tracks.

On the south wall the top of the excavation was cut approximately 26 feet from the north rail of the tracks and extended downward at an approximate 1:1 slope. In places the slope was cut to near vertical to remove arsenic mass in the side wall. Where the slope was cut nearly vertical it was immediately backfilled to secure the slope. The excavation extended to the water table over much of the Railroad Avenue area. The depth to groundwater was approximately 22 feet. Test pits dug into the groundwater revealed an unstable base, so the excavation could not be dug deeper.

A total of 19,080.26 tons of soil were excavated from the Railroad Avenue parcel. Of this quantity, 4,691.72 tons required treatment to achieve the disposal standard of less than 5 mg/L leachable arsenic. The remaining 14,388.54 tons did not require treatment and was sent directly to the Courtney Ridge Landfill. Based on and average arsenic concentration in soil which was 755.5 mg/kg, approximately 13,105 kg of arsenic was removed from the Railroad Avenue area.

The remaining arsenic concentrations in the bottom of the Railroad Avenue areas are shown on Figure 3-8. The XRF results were supplemented with 10% laboratory confirmation analyses. Confirmation data are paired with the XRF results on Figure 3-8. Nineteen (19) of the 31 arsenic concentrations measured on the bottom of the Railroad Avenue excavation are below 200 mg/kg. The highest remaining concentration found was a single detection of 680 mg/kg at the far west end of the excavation.

On Figure 3-8 the location of four sidewall cross-sections are noted. These cross-sections are depicted as A-A’ through D-D’. The sidewall cross-sections with remaining arsenic concentrations are shown on Figures 3-9 through 3-12. Figure 3-9 shows the east sidewall. The remaining arsenic concentrations range from 151 mg/kg to 445 mg/kg. The north sidewall is depicted on Figure 3-10. As shown, most of the sidewall revealed the clean brown loess backfill used in the 2006 RA. The eastern half of sidewall revealed a black shale backfill used in the 2006 RA. Since the black shale backfill was not easily differentiated from native soil via visual cues XFR readings of the arsenic concentrations were noted along the eastern half of the north wall. The remaining arsenic concentrations along the eastern half of the north wall range from 40 mg/kg to 626 mg/kg. The higher concentrations were deeper than 10 feet suggesting that they are indicative of native soil.

Figure 3-11 depicts the west side wall. The remaining arsenic concentrations range from 59 mg/kg to 680 mg/kg. The south wall is in the downgradient direction of the Armour Road Property. It is bound on the south by the BNSF tracks. The remaining arsenic concentrations range along the south wall range from 17 mg/kg to 788 mg/kg (See Figure 3-12). Of the 33 sample points 21 showed results below 300 mg/kg and 12 points showed concentrations above 300 mg/kg. These results show a substantial achievement in that arsenic concentrations that were excavated just to the north of the south sidewall ranged from over 10,000 mg/kg to almost 40,000 mg/kg.

3.5.2 Sutherlands Parcel Excavation

Before beginning the RA in the Sutherlands area a focused study was done under the footprint of the building after the building was torn down. The study was done during the week of August 22, 2016. Nineteen (19) continuous soil cores were drilled on a grid across the Sutherlands building footprint. The coring began along the property line dividing the HABCO parcel from the Sutherland's parcel. This approach of starting near the HABCO parcel was followed so the extent of migration from the HABCO parcel could be defined.

Soil samples were collected from the core tube at the surface, 4', 8', 12', 16', 20, and 24'; the arsenic concentrations in the core samples were recorded using an XRF. Based on the XRF data from the first line of cores along the property boundary step-out cores were drilled to the west, north, and south. Step-out coring continued until the extent of arsenic in soil was defined. A complete assessment of the results of the August study is provided in a report titled "*Soil Study – Sutherlands Parcel*" September 21, 2016.

All data from the study indicated that the lateral migration of arsenic was generally confined to an eight-foot depth interval with very little vertical migration into overlying and underlying soil. The migration had moved laterally about 75 feet to the west of the HABCO property in an area that is directly west of the point where HABCO once had underground mixing vats on their property. Based on the Soil Study the excavation design for the "Sutherlands" portion of the RA was revised to remove the lateral migration found at eight feet and arsenic detected at depth. Figure 3-13 depicts the revised planned excavation incorporated into the design drawings and the final excavation limits of the RA.

The excavation of soil on the Sutherlands Parcel began on November 19, 2016 and ended January 20, 2017. Work began in the center of the known area of arsenic contamination and expanded radially outward. The boundary of the arsenic contamination was known to the east where clean backfill was placed during the RA completed in 2006.

As with the Railroad Avenue excavation real-time in-situ testing of soil was done to guide the excavation and to segregate the excavated soil into piles which were projected to have roughly equal concentrations of arsenic (i.e. low concentrations grouped alone, mid-range concentrations grouped, and high concentrations grouped). As the excavation proceeded south and west arsenic contamination began to increase as the excavation extended beyond the limits of the arsenic detected in the August 2016 soil study. Arsenic contamination continued to increase until a concrete sump was discovered at a depth of about 10 feet. The sump was located outside of the area defined as impacted by the HABCO operations. Additional details of the sump are provided in the next Subsection titled “Excavation of Miscellaneous Materials”.

The sump was removed and even higher arsenic concentrations, many concentrations exceeding 5,000 mg/kg were discovered to the south of the sump. An area of the old land surface at the same elevation of the sump was colored bright yellow and orange from the arsenic apparently migrating from the sump and toward the south. This yellow-orange area measured about one foot thick and covered and area measuring about 20 feet by 20 feet. This same highly contaminated horizon was found to be cleaner toward the HACBO Site with arsenic concentrations of 70 mg/kg to 210 mg/kg to the northeast of the sump.

The area to the south of the sump was excavated laterally and vertically. The bottom of the contamination was found and removed. The excavation to the south became limited by the proximity of fenced areas and KCP&L power poles. The majority of the arsenic contamination was removed; only thin filaments of arsenic were left in place. The arsenic concentrations in the soil mass around the filaments were several orders of magnitude lower than the filaments themselves (often begin several 1,000 mg/kg in the filament and a few 100 mg/kg to less than 100 mg/kg in the soil mass).

Other wastes were found in the soil south of the sump. The other wastes included iron, tar, and a char-like substance. The other wastes could not be segregated from the arsenic so they were removed to the extent that the arsenic was removed. Further discussion on the arsenic removed and left in place is provided below under the discussion of the arsenic left in place at the bottom and sidewalls of the excavation.

There was a distinct organic chemical odor within portions of the Sutherlands excavation where the tar substances were found. The ambient air was monitored using a Photo Ionizing Detector (PID) to test for organic vapors when odors were noted. The detector was a RAE MiniRAE 3000 PID. Before being used the PID was calibrated with 100 ppm isobutylene gas. Odorous soil samples were placed in a zip-lock bag and PID measurements were taken from the headspace. Organic vapor concentrations in soil samples collected from the Sutherlands excavation ranged from 50 to 75 ppm. Samples of the odorous soil were collected for laboratory analysis of volatile and semi-volatile organic constituents following analytical methods 8260 and 8270 respectively. The analyses were done to ensure the safety of the workers and to document that the waste profile for the landfill was not materially changed due to different waste characteristics in the soil.

The only organics detected were:

- Phenanthrene from 3,330 µg/kg to 7,940 µg/kg;

- P-Isopropyltoluene from 1,840 µg/kg to 2,560 µg/kg; and
- Napthalene from 772 µg/kg to 1,200 µg/kg.

These low concentrations did not affect the waste profile; worker safety was maintained by using the PID whenever odors were noticed.

Once the Sutherlands area excavation was completed to the south digging continued to the north. The excavation strategy toward the north was to expose the clean fill from the 2006 RA along the east side wall and to follow the clean fill line to the north and northwest, measuring the arsenic concentrations in-situ, thus guiding the amount of soil to be excavated downwards and laterally. Through the mid-section of the Sutherlands excavation area this testing and excavation strategy revealed arsenic concentrations and extent that were consistent with the findings of the August 2016 soil study (arsenic concentrations were highest near the HABCO/Sutherlands property line and diminished toward the west.

This orderly excavation process and predicable lateral distribution of arsenic in soil was disrupted toward the northern area of the excavation area when six large foundation slabs on wood post piers were discovered about five feet below the ground surface. The piers were over 20 feet long. The concrete slabs were about two feet thick and had an octagon shape. More details of these slabs are provided below in the next Subsection titled "Excavation of Miscellaneous Materials".

After the slabs were removed high arsenic concentrations were found shallow (less than five feet) and deep (up to 20 feet deep) west of the slabs and piers. The shallow arsenic in soil would not have migrated via a subsurface route from the HABCO Site. Many arsenic concentrations exceeded 20,000 mg/kg to the west of the slabs. These very high arsenic concentrations were much higher than the concentrations detected along the HABCO/Sutherlands property line which measured generally less than 1,000 mg/kg, with a few concentrations peaking at approximately 2,500 mg/kg along the property line. Also the arsenic along the properly line was present as filaments that diminished to the west, while the arsenic west of the slabs and piers was present as a bright yellow and orange mass.

Other wastes were found in the soil all around the slabs. The other wastes included copper which colored the soil in places bright green, iron which colored the soil in places dark red, tar, and a char-like substance. The other wastes could not be segregated from the arsenic so they were removed to the extent that the arsenic was removed. Further discussion on the arsenic removed and left in place is provided below under the discussion of the arsenic left in place at the bottom and sidewalls of the excavation.

Though the contamination associated with the slabs was identified as a source separate from the HABCO and CD directive, the slabs and piers were removed and the soil was excavated so the principal objective of the CD, to remove source materials that could affect groundwater quality, could be met. The excavation continued laterally to the west and downward to groundwater. The excavation toward the west was considered complete when the remaining arsenic in soil was present as thin filaments where the arsenic concentrations in the soil mass around the filaments were several orders of magnitude lower than the filaments themselves (often begin several 1,000 mg/kg in the filament and a few 100 mg/kg to less than 100 mg/kg in the soil mass). Shallow contamination, less than five feet deep, was left in areas of the Sutherlands parcel that were paved when the excavation ceased. The shallow contamination was clearly not associated with lateral migration from the HACBO parcel as it consisted of char.

The Sutherlands excavation extended to the lateral limits shown on Figure 3-13. The depth of the excavation ranged from 12 to 22 feet. Groundwater was encountered at 22 feet.

.A total of 25,161.7 tons of soil were excavated from the Sutherlands parcel. Of this quantity, 8,547.11 tons required treatment to achieve the disposal standard of less than 5 mg/L leachable arsenic. The remaining 16,614.59 tons did not require treatment and was sent directly to the Courtney Ridge Landfill. Based on the average arsenic concentration in soil which was 639.1 mg/kg, approximately 14,619 kg of arsenic was removed from the Sutherlands area.

The remaining arsenic concentrations on the bottom of the Sutherlands excavation are shown on Figure 3-14. The XRF results were supplemented with 10% laboratory confirmation analyses. The laboratory results are paired with their XRF results on Figure 3-14. The remaining arsenic concentrations range from 13 mg/kg to 608 mg/kg. Thirty seven (37) of the remaining arsenic concentrations are below 200 mg/kg and 23 are above 200 mg/kg.

On Figure 3-14 the location of six sidewall cross-sections are noted. These cross-sections are depicted as A-A' through F-F'. The sidewall cross-sections with remaining arsenic concentrations are shown on Figures 3-15 through 3-20. Figure 3-15 shows the sidewall northwest of the former building slabs. The remaining arsenic concentrations range from 80 mg/kg to 347 mg/kg. There are lenses of arsenic filaments that were noted by their yellow/orange color, and a layer of black char remains along this sidewall. The approximate locations of the filaments and char are noted on the figure. It is not known how far the filaments and char extend to the northwest. Figure 3-14 notes areas lateral to the sidewalls where there is a high probability that filaments and other industrial wastes related to the Sutherlands parcel may be located. The lateral notations on Figure 3-14 are based only on the sidewall observations. Given the past industrial nature of the Sutherlands parcel contamination may be present beyond the RA excavation and not noted on Figure 3-14.

The west sidewall is depicted on Figure 3-16. As shown, the southern half of the sidewall is generally clean with arsenic concentrations ranging from not detected to 65 mg/kg. As the sidewall encompassed the area west of the former building slabs numerous arsenic filaments and char layers remain in place. The arsenic concentrations in the filaments are several 1,000 mg/kg with a maximum known concentration of almost 6,000 mg/kg. The sidewall data shows the mass of soil around the filaments has generally low arsenic concentration ranging from 31mg/kg to 433 mg/kg.

The remaining arsenic concentrations along the southern sidewall range from 38 mg/kg to 254 mg/kg (See Figure 3-17). The south sidewall is in the area of the former sump discovered during the RA. As with the area around the former building slabs to the north, there are several arsenic filaments along the south sidewall with concentrations of several 1,000 mg/kg with a maximum known concentration of 6,000 mg/kg. The lateral notations on Figure 3-14 of contamination further to the south of the excavation sidewall are based only on the sidewall observations. Given the past industrial nature of the Sutherlands parcel contamination may be present beyond the RA excavation and not noted on Figure 3-14.

Figure 3-18 depicts the east sidewall. This is the sidewall that abuts the RA completed in 2006. As shown, most of the sidewall revealed the clean brown loess backfill used in the 2006 RA. The northern quarter of the sidewall revealed a black shale backfill used in the 2006 RA. Since the black shale backfill was not easily differentiated from native soil via visual cues XFR readings of the arsenic concentrations were noted along the eastern half of the north wall. The remaining arsenic concentrations range from not detected to 658 mg/kg. The southern quarter of the eastside wall could not be cut further east due to guywire supports for a power pole. The remaining arsenic concentrations in this southern quarter ranged from 174 mg/kg to 489 mg/kg.

Figures 3-19 and 3-20 depict the northern and western sidewall respectively of the narrow slot cut area of the Sutherlands excavation. The remaining arsenic concentrations range from 26 mg/kg to 401 mg/kg. There are several arsenic filaments located along the west wall of the slot excavation.

3.5.3 Excavation of Miscellaneous Materials

Underground structures such as the storm sewer under Railroad Avenue and the municipal water pipe were known to exist; several miscellaneous materials and structures were discovered during the excavation. The following describes the status of the underground structures at the Site. The structures are:

1. Storm sewer (known);
2. Municipal water pipe (known);
3. Sump (discovered);
4. General Piping/Utilities (discovered),
5. Building foundations (discovered); and
6. Contamination not associated with HABCO

Storm Sewer

Approximately 240 feet of the 72” reinforced concrete storm sewer pipe (RCP) under Railroad Avenue was removed, crushed, and sent to Obermeyer Reclaim in Independence Missouri. Approximately 330 feet of new 72” RCP was use to replace the storm sewer when the Railroad Avenue excavation was in the backfill phase. The course of the RCP was altered from the original alignment to better align the sewer with the future development plans for the region. The added 90 foot length was installed to provide the City of North Kansas City with a convenient location to hook in future storm sewer systems that will serve the large development of the area in the future.

Municipal Water Pipe

To complete the Railroad Avenue RA the municipal water pipe crossing the RA area was taken out of service, removed, and then replaced when the RA was complete. To take the water pipe out of service a valve was hot-tapped into the pipe about one foot north of the BNSF property line. A second valve exists in the pipe along Armour Road. The Armour Road valve and the new valve were shut isolating the segment of the water pipe crossing the Railroad Avenue RA. Approximately 240 feet of 10 inch ductile iron pipe was removed from the RA area. The pipe was sent to Obermeyer Reclaim for recycling.

When the Railroad Avenue RA was complete the water pipe was replaced with new 10” ductile iron pipe. Given that the alignment of replaced Railroad Avenue was moved toward the north of the original trace the alignment of the new pipe was placed south of the new road and crossed to the north to connect to the existing pipe at the far eastern end of the Railroad Avenue RA. The length of the replacement pipe is approximately 250 feet.

Sump

A concrete sump was found on the Sutherlands parcel, near the southern end of the Sutherlands RA. This sump was not known to exist. The sump was approximately 20 feet long and about 3 to 4 feet thick in places. Several smaller concrete blocks that appear to be small foundations for small structures adjacent to the sump were also discovered. Upon the discovery of the sump and adjacent small foundations historical aerial photos were obtained which showed a past industrial operation in the area. The industrial operation seen in the aerial photo are the sump and small adjacent structures, and what appears to be a conveyor leading from the sump to several multi-story tall buildings along the north end of the Sutherlands RA excavation. The 1969 aerial photo is provided as Figure 3-21. The location of the known arsenic mass relative to the location of the sump is shown on Figure 2-22.

To meet the objectives of the RA under the CD the concrete sump and adjacent foundations were moved out of the way of the excavation and the soil containing arsenic and other contaminants such as char were excavated. When the excavation was complete around the sump concrete dust was drilled from the concrete blocks and tested for arsenic with the XRF. No arsenic was detected so the concrete was placed back in the excavation at depth of about 18 feet.

General Piping/Utilities

Two remnant pipes, roughly 3” in diameter, were found traversing the center of the Sutherlands RA area. These pipes were not known to exist. The pipes trended east to west (See Figure 3-22). These pipes were removed and disposed at the Courtney Ridge Landfill.

A natural gas pipeline was known to exist. The pipe traversed the property line between the Sutherlands and HABCO parcels starting from near Armour Road and terminating adjacent to what had been the center of the east wall of the Sutherlands building. The gas service had been disconnected at Armour Road when the building was torn down. The natural gas pipe was removed and disposed at the Courtney Ridge Landfill.

A telephone communications line was known to exist. The communications line traversed the property line between the Sutherlands and HABCO parcels starting from near Armour Road and terminating adjacent to what had been the center of the east wall of the Sutherlands building. The communication line was located near and parallel to the natural gas pipe. The telephone service had been disconnected at Armour Road. The communications wire was removed and disposed at the Courtney Ridge Landfill.

Remnant Foundations

Six large concrete foundations supported on up to eight 12” diameter treated wood post piles per foundation were found on the Sutherlands property, near the northern end of the Sutherlands RA. These foundations were not known to exist. The foundations were approximately two feet thick and were square and octagonal in shape. The foundations were approximately 10 feet across and were arranged in two rows of three foundations. Several smaller concrete blocks that appear to be small foundations for small structures were found adjacent to the slabs and along a line from the slabs to the sump to the south.

As with the discovery of the sump the historical aerial photos were reviewed that showed the past industrial operations in the area. The 1969 aerial photo is provided as Figure 3-21. The locations of the arsenic mass associated with the historical industrial artefacts are shown on Figure 3-22. It is apparent that the Sutherlands parcel was filled to a higher grade and developed in the 1970’s without cleaning the parcel of the contamination and subsurface structures that existed on the site prior to 1970.

To meet the objectives of the RA under the CD the slabs, piers, and adjacent foundations were moved out of the way of the excavation and the soil containing arsenic and other contaminants such as char were excavated. When the excavation was complete the concrete slabs and blocks were placed back in the excavation at depth of about 18 feet. The wood pole piers were disposed at the Courtney Ridge Landfill.

Contamination not Associated with HABCO

As described above, once the sump and foundation slabs were removed from the Sutherlands Parcel the excavation continued. As stated earlier, and is important to restate, the Respondent has provided evidence that the areas excavated to the south of the sump and west of the foundation slabs were not contaminated by the HABCO Site, but contained contaminants from the industrial operations present on the Sutherland Parcel prior to 1970. The evidence of the second source concept is as follows:

- The contaminants had copper and iron wastes in concentrations significant enough to stain the soil green and red; there were also tar and char present. The contamination associated with the HABCO parcel was arsenic alone, migrating laterally through soil in a predictable pattern.

- Arsenic concentrations were elevated at depth (10 to 20 feet) along the HABCO/Sutherlands property line and concentrations declined toward the west. In the vicinity of the slabs the arsenic concentrations increased, more than quadrupling.

- Contamination was found shallow to the west of the slabs. The migration pattern from the HABCO parcel was via the subsurface so shallow impacts on Sutherlands would not have come from the HABCO parcel.

The Respondent elected to voluntarily remove soil from this second source area because apportioning the arsenic in groundwater between the HABCO Site and the historical Sutherlands industrial operations would disrupt the progress toward a long term monitoring final response action for Site under the CD. This voluntary effort was done solely for overall environmental benefit and not as recognition of responsibility.

The soil unique to past operations was not segregated and tracked separately during the RA. Measuring the areas around the sump and foundations the following estimate is made of the soil unrelated to HABCO that was removed:

- Sump area - 40’ x 30’ x 16’ = 711 cubic yards (CY) = 1,240 tons
- Foundation area – 50’ x 55’ x 18’ = 1,833 CY = 2,930 tons

3.5.4 Post Off-haul Soil Staging Area Clean-up

The soil piles were staged and managed in areas of the Site that had native soil at the surface. It was critical that the soil staging did not leave contamination on the native soil. Once all the soil piles were removed from the Site the native soil under the soil staging areas was analyzed for arsenic with an XRF. The XRF testing was done on a rectangular grid. If the average native soil XRF results around a grid node were elevated then soil was scraped again and the native soil was re-tested with the XRF. The staging areas were scraped in approximately six-inch intervals until the average overall arsenic concentrations across the grid were less than 70 mg/kg. The final grid concentrations of arsenic were documented. Figure 3-23 shows the Railroad Avenue grid Figure 3-24 shows the Sutherlands grid.

At each grid node the arsenic concentrations were noted. When native soil XRF results exceeded and average of 70 mg/kg arsenic in an area, then approximately 6" of soil was scraped and the native soil was retested with the XRF. The process of grid testing and scraping continued until the overall average arsenic concentration across the grid was less than 70 mg/kg. At any single grid node where an outlier arsenic concentration was noted XRF measurements were taken around the grid node to determine if the outlier was a pattern in the node area of if the result was a single concentration detected in and otherwise area of low residual arsenic in soil.

The Railroad Avenue soil pile staging area was cleaned to residual arsenic concentrations that ranged from not detected to 124 mg/kg. The average residual concentration is 27 mg/kg. The Sutherlands soil pile staging area was cleaned to residual arsenic concentrations that ranged from not detected to 356 mg/kg. The average residual concentration is 127 mg/kg. Arsenic concentrations were re-measured around the points where point concentrations were over 300 mg/kg and the area around the nodes had residual arsenic concentrations well below 70 mg/kg and in places, single digits.

The soil piles created by scraping the staging areas were tested for arsenic and were found to contain an average arsenic concentration of less than 70 mg/kg. The soil scrape piles were used as backfill in the RA excavation.

3.6 DOCUMENTATION OF MAXIMIZING THE MASS OF ARSENIC REMOVED

The objective of the RA was to maximize the mass of arsenic removed from the Site, with a particular focus on arsenic mass at or near the water table. A key provision of the RA was to remove potential sources of arsenic that are, or could, impact groundwater quality. The reasonable limitations to the excavation established at the start of the RA were as follows:

1. Maintain stable slopes along the BNSF railroad tracks to the south of the Railroad Avenue excavation;

2. Encroaching upon structures such as KCP&L power poles not moved for the RA;

3. Having to remove an exorbitant amount of overburden to access a small mass of contaminated soil.

The approach to maximizing the mass removed in each RA area is discussed below.

3.6.1 Maximizing Arsenic Mass Removed - Railroad Avenue

Considering boundary item 1, the railroad tracks, the maximum removal of arsenic contaminated soil was achieved by starting the excavation cut approximately 26 feet from the north rail of the tracks. The side wall along the tracks was cut to a 1:1 slope with some areas cut to near vertical to remove the maximum arsenic mass from the Railroad Avenue area. Areas to the south east, and west in the Railroad Avenue RA were cut to clean fill placed during the 2006 RA, or in the case of the east cut, to arsenic concentrations that were approximately 400 mg/kg. Throughout the Railroad Avenue excavation area soil was removed to the water table where needed to remove arsenic mass. The excavation downward ceased when water began to flow upward into the open excavation.

3.6.2 Maximizing Arsenic Mass Removed – Sutherlands Parcel

Boundary items 2 and 3 were encountered in the Sutherlands excavation. To the south of the old sump that was left behind from historical industrial operations on the Sutherlands parcel, the excavation continued until it encroached upon the KCP&L power poles. The excavation was continued to the extent possible as a narrowing trench between the two poles, removing all arsenic that was present as a contiguous mass. Where an arsenic mass was noted in the sidewall, the mass was point-excavated, undercutting the sidewall where needed to remove the defined mass.

In the southern area, and elsewhere in the Sutherlands excavation area, sidewalls were cut until the defined arsenic mass in soil was removed. Filaments of arsenic were left in place in the sidewall when all four of the following criteria were met:

1. The filaments were a few inches thick or less;
2. The filaments were not laterally continuous beyond 6 to 8 feet;
3. The arsenic concentration in the soil surrounding the filaments approximately an order of magnitude lower than the concentration within the filament; and
4. The thickness of clean overburden exceeded five feet.

These criteria were applied to the south, west, and north wall of the excavation. The east wall was cut to clean fill placed during the 2006 RA. Throughout the Sutherlands parcel soil was removed down to a depth where the arsenic concentrations were dissipating to a few 100 mg/kg (typically a depth of 12 feet) compared to overlying mass that had arsenic concentrations well over 1,000 mg/kg, or to the water table, whichever was encountered first. The excavation to the water table ceased when water began to flow upward into the open excavation.

3.6.3 Summary of Total Mass Removed.

A total of 44,241.96 tons of soil were removed from the Site under the RA. Using the average concentration of arsenic in the soil as determined by the analysis of soil piles sent to the landfill, 27,724 kg of arsenic (about 30.5 tons) was removed from the Site. The breakdown of the soil mass and arsenic mass removed is shown on Table 3-2.

3.6.4 Arsenic Mass Remaining

The mass of arsenic remaining at the Site cannot be accurately calculated as it does not exist as a bulk mass, but as thin filaments. The locations where arsenic remains in and beyond the sidewalls of the excavation shown on Figures 3-14 through 3-20 are generalizations based on observations of the sidewalls. It is evident from the discoveries made during the RA and the 1969 aerial photo that the Sutherlands has an industrial history and residual contamination from those industrial operations may exist over wider areas of the parcel than we have noted.

In the excavated area the filaments were found to be irregular, at times forming defined masses, and then returning to an irregular migration pattern. The arsenic has an affinity for organic substances, particularly wood. The filaments are easily identified visually by their yellow/orange color. However, the absence of color does not mean that the soil mass is free of arsenic.

4.0 COMPLETION OF THE RA AND DEMOBILIZATION

To complete the RA the follow tasks were conducted:

1. Backfilling to a usable and stable grade;
2. Installing temporary storm water drop inlets (DIs);
3. Directing storm water to flow across the new grades;
4. Rebuilding RR Ave;
5. Removing internal roads;
6. Proving soil under the soil pile management areas was not contaminated;
7. Removing the field office and fencing;
8. Repairing a groundwater monitoring well; and
9. Meeting with NKC and EPA to discuss demobilization.

Each of these demobilization activities are discussed below.

4.1 BACKFILL, TEMPORARY DIs, AND DRAINAGE

The both the Railroad Avenue and Sutherlands parcels were backfilled and graded to drain. Details of the backfilling operation are provided below.

4.1.1 Backfill Specifications and Borrow Source

Imported fill backfill was obtained from Tom Peace. The soil was brown loess, commonly used as structural fill in the region. Import soil was tested for the following parameters:

- VOCs by EPA Method 8260;
- SVOCs by EPA 8270 (base-neutral fraction);
- 8 RCRA Metals (EPA methods 6010/7421);
- PCBs by EPA Method 8082; and
- Geotechnical data (proctor, percent moisture, density)

The analytical chemistry testing results for the imported fill samples are provided in Appendix J. Geotechnical data and the compaction report are provided in Appendix K. In summary, all detected compounds in imported fill samples met the backfill specifications. The concentrations of metals, including arsenic, were consistent with background values. Based on testing data, the imported fill was deemed acceptable for use on the Site.

4.1.2 Backfilling and Compaction

Backfill was placed as the excavation was completed in portions of the Site. The excavation and backfill operations were balanced to keep as little of the excavation open as practical. Upon reaching the maximum depth possible in an area, a bridging material was placed over soft native material when needed, and backfilling commenced. The bridging material was needed to achieve compaction on the fill placed directly on the soft native sand. The bridging material was limestone rock measuring approximately two to three inches in diameter.

Compaction testing was done daily as backfilling was being done. The results of the compaction testing are provided in Appendix K. The compaction specification of 95% of the standard proctor was achieved in all areas of the Site.

4.1.3 Temporary DIs

Two temporary drop inlets (DIs) were installed, one at the western terminus of the 72” storm water pipe placed under Railroad Avenue, and one to the north of Railroad Avenue in the lowest area of the HABCO parcel. The HABCO parcel is naturally lower than the surrounding grade so it drains internally. The locations of the temporary DIs are shown on Figure 4-1.

The DIs are temporary because the entire RA area will be developed by the City of North Kansas City. Development plans are already in place and should commence in 2017. The development will change the grades in the RA areas and an entirely new regional storm water drainage system will be installed by NKC.

The temporary DI at the western terminus of the 72” storm water pipe is a 12” vertical pipe that enters the crown of a 36” corrugated plastic pipe that is connected to the 72” RCP. A metal grate covers the DI and rock was placed around the inlet to filter sediment. The DI is protected with posts and orange fencing.

The temporary DI to the north of Railroad Avenue is a concrete vault covered with a heavy metal grate. A 6” plastic pipe conveys collected storm water into the back of the permanent drop inlet installed on the north side of the new section of Railroad Avenue. The temporary DI is protected with posts and silt fencing.

4.1.4 Surface Grades/Drainage

The backfill was brought to the level that closely matched the pre-RA layout and drainage conditions. The fill was graded to drain in three directions, to the north to the permanent DIs near Armour Road, to the south toward the temporary DI at the terminus of the 72” pipe, and to the east toward the temporary DI on the HABCO parcel (See Figure 4-1). The slopes are gentle. The entire grades will be revised by the development planned for the entire RA area in 2017.

Topsoil was not placed over the RA area because the entire area will be regraded for the development in 2017. Should the development of RA areas be delayed the area will be seeded in the growing season if requested by the City of North Kansas City.

4.2 REBUILD RAILROAD AVENUE

Railroad Avenue was rebuilt to specifications established by Olsson and Associates, an engineering firm contracted to the City of North Kansas City. The road is slightly different than the original road.

1. The road tract is north of the original road;
2. The road grade is higher than the original grade;
3. The road is entirely asphalt, (7" of base asphalt and 2" of a top layer);
4. The road is wider as it approaches the track crossing, and the road approaches the track at a 90^0 angle;
5. There are two new permanent road curb storm water drop inlets, and
6. Man-hole access was provided to the 72" storm drain.

A permanent storm water drainage ditch was built to the south of the road in the space between the road and the BNSF tracks. The ditch drains to the east and will be vegetated in the spring of 2017, when the growing season starts.

The area of Railroad Avenue not affected by the RA will be rebuilt to a different design by the City of North Kansas City. The road will also be extended to the west. The portion of the road rebuilt as part of the RA is consistent with the larger design plans for the road.

4.3 REMOVE INTERNAL ROADS

Several internal roads were built within the exclusion zone. The internal roads were used by trucks to deliver rock and to be filled with dirt to be hauled to the landfill. The internal roads were built with 3" limestone rock. At the conclusion of the RA the roads were removed with the loader. The piles of rock were tested with the XRF to determine the arsenic concentration. The detected concentrations were well below the "backfill" limit of 70 mg/kg, so the rock was used as backfill in the excavation.

4.4 REMOVAL OF OFFICE AND FENCE

Once the excavation was completed the field office and the perimeter fence was removed. Concrete blocks were left in place along the entrance for Vernon Avenue to discourage trespasser entrance to the property.

4.5 WELL REPAIR

The new location of Railroad Avenue encroached upon GWM -02S. Access to the well was not affected, however; the well had to be extended due to a higher grade in the area. About two feet of

PVC pipe was added to the well as the area around the well was filled for the road. A new well pad was built at the new grade and the well casing was surveyed for its new elevation. The new elevation was recorded in the groundwater monitoring records.

4.6 MEETING WITH USEPA AND NKC

On the final day of the RA a meeting was held at the Site with Mr. Hoai Tran (USEPA) and Mr. Pat Hawver (North Kansas City). The Respondent drove the participants around the RA area verbally describing the work accomplished during the RA and the conditions remaining at the Site, both on the surface and subsurface. Surface use of the Site was passed to, and accepted by, the City. Digging below the surface of the Site is restricted, via the verbal communication, until the remaining environmental conditions described in this report are fully communicated to all parties and institution controls are put in place to guide subsurface work.

This documentation report does not establish institutional controls and should only be use as a guide to what can reasonably be expected to remain below grade across the parcels affected by the RA. Unknown contamination may exist beyond the limits of the RA excavation and backfill. Current and future site owners should work with the USEPA and MDNR to establish formal institutional controls for the parcels.

5.0 POST CLOSURE RESTRICTIONS AND ACTIVITIES

One post closure restriction and one activity are needed.

5.1 RESTRICTIONS

Post Site closure access restrictions are needed for the Site. The principal area subject to restrictions is the Sutherlands parcel, however; arsenic does remain in the Railroad Avenue area, primarily within 26 feet of the tracks.

The restrictions on the Sutherlands parcel are driven by contaminants of differing types remaining below the ground surface. The known contaminant types are arsenic, copper, iron, char, and tar. The location of remaining contaminants is difficult to assess due the past industrial nature of the Sutherlands parcel. Access restrictions should include establishing appropriate deed restrictions that will address maintenance requirements and the communication mechanisms to ensure that future developers of the Site are aware of the conditions of the Site and can take proper measures when developing the Site.

5.2 POST CLOSURE ACTIVITIES

The post-closure activity is to document the effectiveness of the RA and to document the presence of natural attenuation properties present in the groundwater that will support Long-Term Monitoring (LTM) as the Final Response Action for the Site. Both the effectiveness of the RA and the documentation of the presence of natural attenuation properties of the groundwater will be studied in a groundwater monitoring program conducted in 2017. Based on the results of the study a final LTM program will be established as the work under the CD progresses to a final Feasibility Study and a Record of Decision. The plan for groundwater monitoring and the natural attenuation processes studies will be provide separately from this RA documentation report.

6.0 PHOTOGRAPHIC DOCUMENTATION

Photographs taken during response action implementation are provided in this section. The photographs were selected to provide a general overview of the various cleanup activities and Site control elements. The order of the photos generally follow the order of the work.